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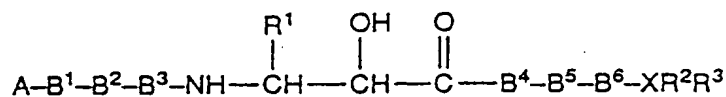
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HIV protease inhibitors.

Human immunodeficiency virus (HIV) protease inhibitors comprising a compound represented by the following general formula or pharmaceutically acceptable salt thereof:



The inhibitors are effective for treating a patient suffering from AIDS and AIDS related diseases.

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BACKGROUND OF THE INVENTIONField of the Invention:

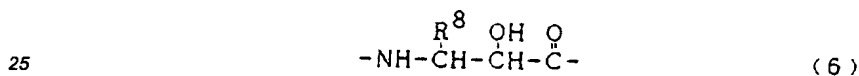
5 This invention relates to peptide derivatives which inhibit human immunodeficiency virus (HIV) protease and pharmaceutically acceptable salts thereof.

Description of the Related Art:

10 Heretofore, various efforts for the therapy of acquired immunodeficiency syndrome (AIDS) and prevention of infection of the human immunodeficiency virus (HIV) by inhibiting the HIV protease have been performed. Some peptide derivatives have been proposed as the inhibitor, for example, EP 357332, EP 337714, EP 372537, EP 378497 and EP 373549.

15 Some HIV protease inhibitors contain hydroxyamino acid isosteres, and in addition, a formation of hydrogen bond between the hydroxy group and Asp25 in the active site of HIV protease was proposed [cf. Proc. Natl. Acad. Sci., U.S.A., 87, 8805 (1990)].

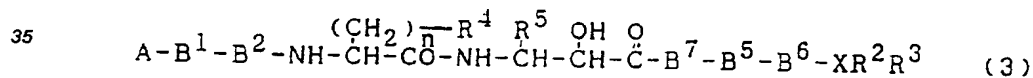
Also, a renin inhibitor having a β -amino- α -hydroxy-carboxylic residue shown by the following general formula (6) as an amino acid isostere in a peptide chain was proposed [e.g. Japanese Unexamined Patent Publication No. 101098 (1990)] and the preparation of said carboxylic acid was reported in relation to an anti-cancer agent [e.g. J. Med. Chem., 20, 510 (1977), *ibid.*, 33, 2707 (1990)].



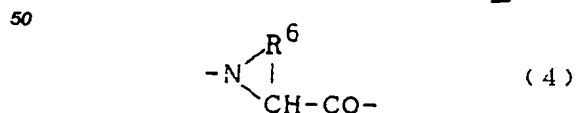
In the general formula (6), R^8 represents a straight or branched lower alkyl group, a cycloalkyl-lower alkyl group, a lower alkoxy-carbonyl-lower alkyl group or an amino-lower alkyl group.

30 However, no β -amino- α -hydroxy-carbocyclic acid mentioned above has been used as amino acid isostere in an HIV protease inhibitor.

Further, no compound having the following basic structure represented by the general formula (3) has been known.



40 where n represents 1 or 2, A represents hydrogen atom or a peptide N-terminal protective group, B^1 , B^2 , B^5 , and B^6 represents independently singly bond or amino acid residue optionally the amino group of said amino acid be substituted with a hydrocarbon residue having 12 or less carbon atoms, B^7 represents a single bond or an amino acid residue represented by the following formula (4') with a proviso that XR^2R^3 represents the following general formula (4') when B^7 is a single bond, X represents nitrogen atom or oxygen atom, R^2 and R^3 each represents hydrogen atom or an optionally substituted hydrocarbon group having 12 or less carbon atoms which form cycles by forming bonds between said carbon atoms which may optionally be replaced with oxygen, 45 nitrogen or sulfur atom with the proviso that no R^3 is present when X represents oxygen atom, R^4 represents carbamoyl group, carboxy group, cyano group, an alkoxy-carbonyl group, hydroxy group, a lower alkoxy group, a lower alkylthio group, a lower alkanesulfonyl group, sulfonyl group, a lower alkanesulfinyl group or sulfamoyl group, and R^5 represents an optionally substituted arylmethyl group:



55 where R^6 and R^7 represents a bivalent hydrocarbon group forming a 5-7 membered ring optionally substituted or fused with the other 5-7 membered ring, and a part of carbon atoms in said rings optionally replaced with hetero atoms.

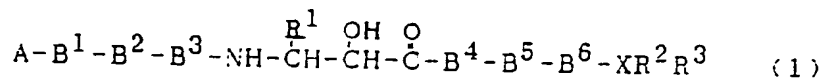
SUMMARY OF THE INVENTION

The present invention provides novel HIV protease inhibitors.

It provides novel compounds with said inhibitory action having β -amino- α -hydroxycarboxylic acid residue as an amino acid isostere.

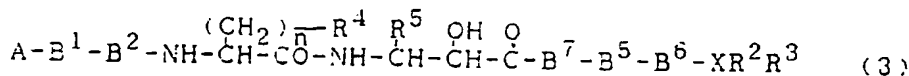
The present invention includes the following HIV protease inhibitors:

Human immunodeficiency virus (HIV) protease inhibitors comprising a compound represented by the following general formula (1) or pharmaceutically acceptable salt thereof:

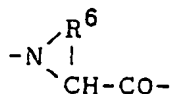


where A represents hydrogen atom or a peptide N-terminal protective group, B¹, B², B³, B⁴, B⁵, and B⁶ represent independently single bond or amino acid residue in which the amino group optionally substituted with a hydrocarbon group having 12 or less of carbon atoms with a proviso that the presence of at least one of said B¹ through B⁶ is necessary, R¹ represents a lower alkyl group, an alicyclic hydrocarbon group, an aromatic hydrocarbon group or a heterocyclic group, each optionally substituted with amino group, mercapto group, hydroxy group, carboxy group, carbamoyl group, an alicyclic hydrocarbon group, an aromatic hydrocarbon group or a heterocyclic group, X represents nitrogen atom or oxygen atom, and R² and R³ each represents hydrogen atom or a hydrocarbon group having 12 or less carbon atoms which may form cycles of which carbon atoms may optionally be replaced with oxygen, nitrogen or sulfur atom with the proviso that no R³ is present when X represents oxygen atom.

The present invention includes the following novel compounds and HIV protease inhibitors containing said compounds or pharmaceutically acceptable salts thereof:



where n represents 1 or 2, A represents hydrogen atom or a peptide N-terminal protective group, B¹, B², B⁵, and B⁶ represents independently singly bond or amino acid residue optionally the amino group of said amino acid be substituted with a hydrocarbon residue having 12 or less carbon atoms, B⁷ represents a single bond or an amino acid residue represented by the following formula (4) with a proviso that XR²R³ represents the following general formula (4') when B⁷ is a single bond, X represents nitrogen atom or oxygen atom, R² and R³ each represents hydrogen atom or an optionally substituted hydrocarbon group having 12 or less carbon atoms which form cycles by forming bonds between said carbon atoms which may optionally be replaced with oxygen, nitrogen or sulfur atom with the proviso that no R³ is present when X represents oxygen atom, R⁴ represents carbamoyl group, carboxy group, cyano group, an alkoxycarbonyl group, hydroxy group, a lower alkoxy group, a lower alkylthio group, a lower alkanesulfonyl group, sulfonyl group, a lower alkanesulfinyl group or sulfamoyl group, and R⁵ represents an optionally substituted arylmethyl group:



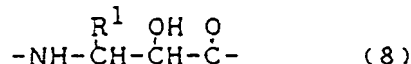
where R⁶ and R⁷ represents a bivalent hydrocarbon group forming a 5-7 membered ring optionally substituted or fused with the other 5-7 membered ring, and a part of carbon atoms in said rings optionally replaced with hetero atoms. Herein "lower" as applied to "alkyl", "alkoxy", "alkane" etc., indicates a preference for a said group of up to 6 carbon atoms.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1-6 show NMR spectra of the compounds of Examples 82, 86, 100, 106, 130 and 178, respectively.

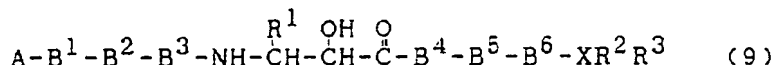
DETAILED DESCRIPTION OF THE INVENTION

The inventors found that peptide derivatives having an amino acid isostere of β -amino- α -hydroxycarboxylic acid residue represented by the following general formula (8) exhibit inhibition of HIV protease



In the general formula (8), R¹ represents a lower alkyl group, an alicyclic hydrocarbon group, an aromatic hydrocarbon group or a heterocyclic group optionally substituted with amino group, mercapto group, hydroxy group, carboxy group, carbamoyl group, an alicyclic hydrocarbon group, an aromatic hydrocarbon group or a heterocyclic group. The inhibitory activity may be derived from a hydrogen bond formed between a hydroxy group of above mentioned β -amino- α -hydroxycarboxylic acid residue and Asp25 in the active site of HIV protease, and also from the other hydrogen bond formation by a carbonyl group in the active site. The inhibitory activity is presumed to be enforced by fixing the conformation of neighboring amino acid residue by said carbonyl group through the amide bond.

One embodiment of the present invention relates to a human immunodeficiency virus (HIV) protease inhibitor peptide derivatives represented by the following general formula (9) or pharmaceutically acceptable salts thereof.



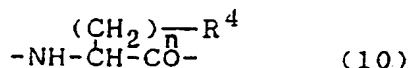
In the general formula (9), A represents hydrogen atom or a peptide N-terminal protective group. The N-terminal protective group includes such as acetyl group (Ac-), propionyl group, butyryl group, isobutyryl group, valeryl group, isovaleryl group, pivaloyl group, hexanoyl group, heptanoyl group, octanoyl group, benzyl group (Ph-CH₂-), benzoyl group, phenylacetyl group (Ph-CH₂-CO-), 3-phenylpropionyl group [Ph-(CH₂)₂-CO-], phenylpropenoyl group, pyridinecarbonyl group (Pyridine-CO-), quinoline-2-carbonyl group (Quinoline-CO-), phenoxyacetyl group (Ph-O-CH₂-CO-), *o*-chlorophenoxyacetyl group (*o*Cl-Ph-O-CH₂-CO-), *m*-chlorophenoxyacetyl group (*m*Cl-Ph-O-CH₂-CO-), *p*-chloro-phenoxyacetyl group (*p*Cl-Ph-O-CH₂-CO-), *o*-phenylphenoxyacetyl group (*o*Ph-Ph-O-CH₂-CO-), *m*-phenylphenoxyacetyl group (*m*Ph-Ph-O-CH₂-CO-), *p*-phenylphenoxyacetyl group (*p*Ph-Ph-O-CH₂-CO-), 1-naphthoxyacetyl group (1Nap-O-CH₂-CO-), 2-naphthoxyacetyl group (2Nap-O-CH₂-CO-), N-(1-naphthyl)-aminoacetyl group (1Nap-NH-CH₂-CO-), glutaryl group [-CO-(CH₂)₃-CO-], succinyl group [-CO-(CH₂)₂-CO-], 3-(*p*-methylbenzyl)thiopropionyl group, diphenylmethoxyacetyl group [(C₆H₅)₂CH-O-CH₂-CO-], bis(*p*-chlorophenyl)methoxyacetyl group [(*p*-ClPh)₂CH-O-CH₂-CO-], (5-isoquinolyloxy)-acetyl group (5Isoquinoline-O-CH₂-CO-), naphthalenecarbonyl group, isoquinoline-1-carbonyl group (1-Isoquinoline-CO-), furancarboxyl group (furan-CO-), thiophenecarbonyl group (thiophene-CO-), methoxycarbonyl group, ethoxycarbonyl group, propoxycarbonyl group, tert-butoxycarbonyl group (Boc-), benzyloxycarbonyl group (Ph-CH₂-O-CO-), 1-naphthyl-methyloxycarbonyl group (1Nap-CH₂-O-CO-), 9-fluorenyl-methoxycarbonyl group (Fmoc-), naphthalene-1-sulfonyl group (1Nap-SO₂-), benzofurancarboxyl group (Benzofuran-CO-), (E)-4-phenyl-3-butenyl group [(E)Ph-CH=CH-CH₂-CO-], *m*-(isopropoxy)phenyloxyacetyl group [*m*-(iPrO)-Ph-O-CH₂-CO-], 5,6,7,8-tetrahydro-1-naphthyloxyacetyl group [1-Tna-O-CH₂-CO-], *m*-(N-phenylamino)phenyloxyacetyl group [*m*-(Ph-NH)-Ph-O-CH₂-CO-], *m*-(morpholinocarbonyl)-phenyloxyacetyl group [*m*-(Morph-CO)-Ph-O-CH₂-CO-], *m*-(piperidinocarbonyl)phenyloxyacetyl group [*m*-(Piper-CO)-Ph-O-CH₂-CO-], 2,3-dimethyl-phenyloxyacetyl group (2,3-diMe-Ph-O-CH₂-CO-) and 8-quinolyloxyacetyl group (8-Qoa-). Among them, aryloxyacetyl groups such as *m*-chlorophenoxyacetyl group, *m*-phenylphenoxyacetyl group, 1-naphthoxyacetyl group, (5-isoquinolyloxy)-acetyl group, *m*-(N-phenylamino)phenyloxyacetyl group are particularly preferable for the marked elevation of HIV protease inhibitory activity. In addition abbreviations used in the above parentheses are used as abbreviations in the specification.

B¹, B², B³, B⁴, B⁵, and B⁶ represent amino acid residues and mean independently natural or un-natural amino acid residue and the corresponding amino acid include, for example, glycine (Gly), alanine (Ala), valine (Val), leucine (Leu), isoleucine (Ile), serine (Ser), threonine (Thr), cysteine (Cys), methionine (Met), asparagine (Asn), glutamine (Gln), phenylalanine (Phe), tyrosine (Tyr), tryptophan (Try), aspartic acid (Asp), glutamic acid (Glu), histidine (His), lysine (Lys), arginine (Arg), proline (Pro), β -acetylalanine (Aca), phenylglycine (Phg), α -allylglycine (Alg), α -propargylglycine (Prg), N-cyclohexylmethylglycine [(cHexm)Gly], N-benzylglycine [(Bzl)Gly], β -alanine (β Ala), β -cyclohexylalanine, β -(naphthyl)alanine, β -cyanoalanine, β -(cyanomethyl)ala-

nine, β -(sulfonylmethyl)alanine, β -(methanesulfonyl)alanine (Msa), β -(methanesulfonylmethyl)alanine [Met(O)₂], β -sulfanylanine, β -(methanesulfinyl)alanine [Smc(O)], sulfanylmethylalanine, β -sulfamoylalanine (Sma), β -methylthioalanine (Mta), β -(dimethylsulfonio)alanine [Mta⁺(Me)], D-valine (D-Val), norvaline (Nva), β -(methanesulfonyl)valine (Msv), β -(methylthio)valine (Mtv), norleucine, tert-leucine (Tle), homoserine (Hse), O-methylserine [Ser(Me)], O-methylthreonine [Thr(Me)], D-phenylalanine (D-Phe), O-methylaspartic acid, β -hydrazinoaspartic acid [Asp(NHNH₂)], O-methylglutamic acid, hydroxyproline (Hyp), 4-benzoyloxypyrrolidine-2-carboxylic acid [Hyp(Bzl)], 4-methoxypyrrolidine-2-carboxylic acid [Hyp(Me)], 4-ethoxypyrrolidine-2-carboxylic acid [Hyp(Et)], 4-allyloxypyrrolidine-2-carboxylic acid [Hyp(Allyl)], cis-4-cyclohexylpyrrolidine-2-carboxylic acid (Ccp), trans-4-cyclohexylpyrrolidine-2-carboxylic acid (Tcp), 4-benzyl-pyrrolidine-2-carboxylic acid, 3-phenylpyrrolidine-2-carboxylic acid (Php), cis-4-phenylpyrrolidine-2-carboxylic acid (Cpp), 4-hydroxy-4-phenylpyrrolidine-2-carboxylic acid (Hpp), 4-phenyl-2,5-dihydropyrrole-2-carboxylic acid (Pdp), 4-methylthiopyrrolidine-2-carboxylic acid, 4-phenylthio-pyrrolidine-2-carboxylic acid, 4-fluoropyrrolidine-2-carboxylic acid, 4,4-di(methylthio)pyrrolidine-2-carboxylic acid [Pro(SMe)₂], 3,3-dimethylpyrrolidine-2-carboxylic acid (Dmp), 2-amino-octanoic acid, 2-aminoheptanoic acid, indoline-2-carboxylic acid (Inc), octahydroindole-2-carboxylic acid, (Oic), octahydrocyclopenta[b]pyrrole-2-carboxylic acid, L-pipecolic acid [(L)-Pip], D-pipecolic acid [(D)-Pip], L-1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid [(L)-Tic], D-1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid [(D)-Tic], decahydroisoquinoline-3-carboxylic acid (3Dic), decahydroisoquinoline-1-carboxylic acid (1Dic), 5,5-dimethyl-1,3-thiazolidine-4-carboxylic acid (Dtc), β -amino isobutyric acid (BAIB), γ -amino butyric acid (BANB), γ -aminobutyric acid (GABA) and 1,3-thiazolidine-4-carboxylic acid (Thz). In addition abbreviations used in the above parentheses are used as abbreviations in the specification.

The amino group in these amino acids may be substituted with a hydrocarbon group having 12 or less carbon atoms. Such hydrocarbon groups include such as methyl, ethyl, benzyl and cyclohexylmethyl groups.

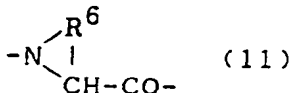
The presence of at least one of the B¹, B², B³, B⁴, B⁵ and B⁶ is sufficient for the definition of general formula, and presence of B³ and B⁴, especially B³, is preferable. The amino acid residues of B³ represented by the general formula (10) are preferable for the improvement of HIV protease inhibitory activity.



In the general formula (10), n represents 1 or 2, R⁴ represents carbamoyl group, carboxy group, cyano group, an alkoxy carbonyl group, hydroxy group, a lower alkoxy group, a lower alkylthio group, a lower alkylsulfonyl group, sulfonyl group and sulfamoyl group.

Their corresponding amino acids include asparagine, glutamine, aspartic acid, glutamic acid, cyanoalanine, cyanomethylalanine, O-methylaspartic acid, O-methylglutamic acid, serine, O-methylserine, β -methylthioalanine, methionine, β -methanesulfonylalanine, β -(methanesulfonyl-methyl)alanine, β -sulfonylalanine, β -sulfonylmethylalanine, β -sulfamoylalanine and β -sulfamoylmethylalanine. Among them, asparagine, β -methylthioalanine and β -methanesulfonylalanine are particularly preferable.

Furthermore, amino acid residues having B⁴ represented by the general formula (11) are also preferable for the improvement of HIV protease inhibitory activity.



In the general formula (11), R⁶ represents a bivalent hydrocarbon group forming a 5-7 membered ring and optionally substituted or fused with the other 5-7 membered ring, some or one of which carbon atoms in said rings may be replaced with hetero atom(s).

The corresponding amino acid include, for example, proline, 4-hydroxypyrrolidine-2-carboxylic acid, 4-benzoyloxypyrrolidine-2-carboxylic acid, 4-cyclohexyl-pyrrolidine-2-carboxylic acid, 4-phenylpyrrolidine-2-carboxylic acid, 3-phenylpyrrolidine-2-carboxylic acid, 4-benzylpyrrolidine-2-carboxylic acid, 4-methylthiopyrrolidine-2-carboxylic acid, 4-phenylthiopyrrolidine-2-carboxylic acid, 4-fluoropyrrolidine-2-carboxylic acid, 4,4-bis(methylthio)-pyrrolidine-2-carboxylic acid, 3,3-dimethylpyrrolidine-2-carboxylic acid, 1,3-thiazolidine-4-carboxylic acid, 5,5-dimethyl-1,3-thiazolidine-4-carboxylic acid, indoline-2-carboxylic acid, octahydroindole-2-carboxylic acid, octahydrocyclopenta[b]pyrrole-2-carboxylic acid, pipecolic acid, 1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid, 1,2,3,4-tetrahydroisoquinoline-1-carboxylic acid, decahydroisoquinoline-3-carboxylic acid, and decahydroisoquinoline-1-carboxylic acid. Among them, proline, 3,3-dimethylpyrrolidine-

2-carboxylic acid, 1,3-thiazolidine-4-carboxylic acid and 5,5-dimethyl-1,3-thiazolidine-4-carboxylic acid are particularly preferable.

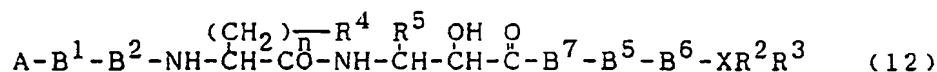
The number of peptide bonds and number of amino acid unit in the molecule is preferably decreased for the better *in vivo* stability and membrane permeability, thus the absence of B¹ and B² is preferable, particularly the absence of B¹, B², B⁵ and B⁶ is more preferable.

The group represented by R¹ means a lower alkyl group, an alicyclic hydrocarbon group, an aromatic hydrocarbon group or a heterocyclic group. Said lower alkyl group includes, for example, methyl group, propyl group, isopropyl group, butyl group, isobutyl group, sec-butyl group, pentyl group, and hexyl group. Said alicyclic hydrocarbon group includes, for example, cyclopentyl group and cyclohexyl group. Said aromatic hydrocarbon group includes, for example, phenyl group, 4-hydroxyphenyl group and 4-methoxyphenyl group. Said heterocyclic group includes, for example, imidazolyl group and indolyl group. Said lower alkyl group, alicyclic hydrocarbon group, aromatic hydrocarbon group, and heterocyclic group may be substituted by amino group, mercapto group, hydroxy group, hydroxyphenyl group, alkoxyphenyl group, carboxy group, carbamoyl group, an alicyclic hydrocarbon group, an aromatic hydrocarbon group or a heterocyclic group. Said substituted lower alkyl group includes, for example, hydroxymethyl group, mercaptomethyl group, 1-hydroxyethyl group, 2-carbamoyl group, 2-carboxyethyl group, carbamoylmethyl group, carboxymethyl group, benzyl group, (4-hydroxyphenyl)methyl group, (4-methoxyphenyl)methyl group, cyclohexylmethyl group, naphthylmethyl group, imidazolylmethyl group, indolylmethyl group, 2-methylthioethyl group and 4-aminobutyl group. Among them, compounds having benzyl group as R¹ is particularly preferable for the marked elevation of HIV protease inhibitory activity.

In the partial formula of -XR²R³, X represents nitrogen or oxygen atom, and R² and R³ represent independently hydrogen atom or a hydrocarbon group having 12 or less carbon atoms optionally replaced with oxygen, nitrogen or sulfur atom, and when X represents oxygen, no R³ exists. Said hydrocarbon group in R² and R³ represents, for example, methyl group (-Me), isopropyl group (-iPr), isobutyl group (-iBu), sec-butyl group (-sBu), 2-pentyl group, 1-ethylpropyl group, tert-butyl group (-tBu), neopentyl group, tert-amyl group (tAmyl), 3-methyl-2-butyl group, 2,3-dimethyl-2-butyl group, cyclohexyl group (-C₆H₁₁), cyclo-hexylmethyl group (-CH₂-C₆H₁₁), cyclopropyl group, cyclo-pentyl group, phenyl group (-Ph), benzyl group, naphthyl group and naphthylmethyl group. Said substituted hydrocarbon group includes, for example, 3-hydroxy-2-methyl-2-propyl group, 1,1-bis (hydroxy-methyl)ethyl group, 1-hydroxymethyl-2-methylpropyl group, 1-hydroxy-2-methylbutyl group, 2-hydroxy-1-phenylethyl group, 2-hydroxycyclohexyl group (-chex-ol), *o*-hydroxyphenyl group [-Ph(*o*-OH)], *m*-hydroxyphenyl group [-Ph(*m*-OH)] and *p*-hydroxyphenyl group [-Ph(*p*-OH)]. Furthermore, when X represents nitrogen atom, said R² and R³ may be bridged to form a ring, and a part of carbon atoms in said rings may be replaced with oxygen, nitrogen or sulfur atom. These groups include, for example, 1,2,3,4-tetrahydroisoquinolin-2-yl group, decahydroquinolin-1-yl group, decahydroisoquinolin-2-yl group (-Diq), 1-indolyl group, octahydroindol-1-yl group, 2-isoindolyl group, octahydroisoindol-2-yl group, 1-pyrrolidinyl group, 1-piperidinyl group (-piperidine), 1-morpholinyl group, 1,3-thiazolidin-3-yl group, 5,5-dimethyl-1,3-thiazolidin-3-yl group, tetrahydro-1,4-thiazin-3-yl group and hexahydro-azepin-1-yl group. In addition abbreviations used in the above parentheses are used as abbreviations in the specification.

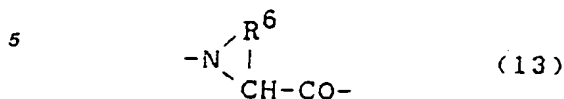
The pharmaceutically acceptable salts of the peptide derivatives in the present invention and represented by the general formula (9) include, for example, inorganic acid addition salts such as hydrochloride, sulfate, and phosphate, organic acid addition salts such as acetate, oxalate, maleate, metal salts such as sodium, potassium and calcium salt, and organic amine salts such as triethylamine salt.

Another embodiment of the present invention relates to novel peptide derivatives and salts thereof represented by the general formula (12).



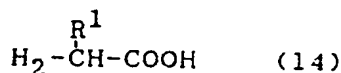
In the general formula (12), n represents 1 or 2, A represents hydrogen atom or a peptide N-terminal protective group, B¹, B², B⁵, and B⁶ represents independently singly bond or amino acid residue optionally the amino group of said amino acid be substituted with a hydrocarbon residue having 12 or less carbon atoms, B⁷ represents a single bond or an amino acid residue represented by the following formula (13) with a proviso that XR²R³ represents the following general formula (13') when B⁷ is a single bond, X represents nitrogen atom or oxygen atom, R² and R³ each represents hydrogen atom or an optionally substituted hydrocarbon group having 12 or less carbon atoms which form cycles by forming bonds between said carbon atoms which may optionally be replaced with oxygen, nitrogen or sulfur atom with the proviso that no R³ is present when X represents oxygen atom, R⁴ represents carbamoyl group, carboxy group, cyano group, an alkoxycarbonyl group, hydroxy

group, a lower alkoxy group, a lower alkylthio group, a lower alkane-sulfonyl group, sulfonyl group, a lower alkanesulfinyl group or sulfamoyl group, and R⁵ represents an optionally substituted arylmethyl group:



where R⁶ and R⁷ represents a bivalent hydrocarbon group forming a 5-7 membered ring optionally substituted or fused with the other 5-7 membered ring, and a part of carbon atoms in said rings optionally replaced with hetero atoms.

The β-amino-α-hydroxycarboxylic acid having the structure represented by the general formula (8) can be synthesized by conventional methods. For example, first the amino group of amino acid represented by the general formula (14) is protected by a known protecting group such as tert-butoxycarbonyl group.



In the general formula (14), R¹ has the same meanings with those in the general formula (9). And then, the carboxy group of the protected amino acid is esterified and hydroxymethyl group is introduced by reduction.

Said hydroxymethyl group is converted into formyl group by the reaction with an oxidant such as dimethylsulfoxide, which is caused to react with sodium cyanide to make cyanohydrin compound. The resultant compound is hydrolyzed, for example, with hydrochloric acid to give the said β-amino-α-hydroxy-carboxylic acid. The groups of general formula (8) have two asymmetric carbon atoms and therefore, compounds having the residue represented by the general formula (8) are often obtained as a mixture of (2S,3S) and (2R,3S) compounds from the starting material of optically active compound represented by the general formula (14), for example S-type compound. In the present invention those mixtures can be used but isomers obtained by a separation by conventional methods such as silica gel column chromatography are preferred. For the separation, suitable protecting group may be introduced to amino group or carboxy group. For example, a compound with general formula (8), such as (2RS,3S)-3-amino-2-hydroxy-4-phenyl-butanoic acid can be separated into (2R,3S) and (2S,3S) isomers by the protection of amino group with tert-butoxycarbonyl group and carboxy group with benzyl ester, followed by silica gel column chromatography.

The peptide derivatives represented by the general formula (9) of the present invention, including pharmaceutically acceptable salts thereof, inhibit cleavage of a peptide substrate, for example, Ac-Arg-Ala-Ser-Gln-Asn-Tyr-Pro-Val-Val-NH₂ [Biochem. Biophys. Res. Comm., 159, 420 (1989)] by chemically synthesized HIV protease, in which two cysteine residues in the reported sequence [Science, 230, 949 (1985)] were replaced with alanine residues, or recombinant HIV protease [Biochemistry, 29, 264 (1990)]. Therefore the peptide derivatives of the present invention can be used as an inhibitor of HIV protease and may be used for the therapy and prevention of AIDS.

The peptide derivatives represented by the general formula (9) can be prepared from amino acid derivatives having the residue represented by general formula (8) by conventional methods in peptide chemistry. L-type amino acid residues are preferred for B¹, B², B³, B⁴, B⁵ and B⁶ in the general formula (9). However, the preferred configuration in the amino acid residue represented by the general formula (8) varies with the neighboring amino acid residue. For example, the preferred configuration in the amino acid residue represented by the general formula (8) means (2R,3S) when B⁴ represents phenylalanine residue, and the preferred configuration means (2S,3S) when B⁴ represents an amino acid residue in the general formula (11). This may be caused by the changes in conformation of peptide chain due to the ring structure of amino acid residue in B⁴ in the general formula (11). Separation of isomers may be carried out after a peptide bond formation started from isomeric mixture of the amino acid derivatives having a residue represented by the general formula (8).

The preferred peptide derivatives represented by the general formula (9) are illustrated in the Tables by the example Nos. Tables 1, 2, 3, 4, 5, and 6 represent a series of compounds.

Table 1

Example	Chemical Formula	Residual Activity (%)	
		1 mM	5 mM
1	Boc-Asn-(2R,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	32.8	
2	Boc-Phe-Asn-(2R,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	19.5	
3	Boc-Asn-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	52.9	
4	Boc-Phe-Asn-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	20.3	
5	Boc-Ser-(2R,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	82.9	
6	Boc-Phe-Ser-(2R,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	33.3	
7	Boc-Ser-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	15.6	
8	Boc-Phe-Ser-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	47.0	
9	H-Asn-(2R,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	92.1	
10	H-Phe-Asn-(2R,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	43.4	
11	H-Phe-Asn-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	16.4	
12	H-Ser-(2R,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	89.7	
13	H-Phe-Ser-(2R,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	58.9	
14	H-Ser-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	95.5	
15	H-Phe-Ser-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	23.8	
16	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂		7.0
17	PhCH ₂ CH ₂ CO-Asn-(2R,3S)-AHPBA-Pro-Ile-Val-NH ₂	1.5	19.3
18	H-Val-Val-(2R,3S)-AHPBA-Phe-Val-Val-NH ₂	1.0	5.6
19	H-Val-Val-(2S,3S)-AHPBA-Phe-Val-Val-NH ₂	5.1	32.1
20	PhCH ₂ CO-Ser-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	2.8	42.8
21	PhCH ₂ CO-Ser-(2R,3S)-AHPBA-Pro-Ile-Val-NH ₂	27.7	80.9
22	H-Val-Val-(2S,3S)-AHPBA-(D)-Phe-(D)-Val-(D)-Val-NH ₂	52.9	
23	H-Val-Val-(2R,3S)-AHPBA-(D)-Phe-(D)-Val-(D)-Val-NH ₂	28.3	
24	H-Val-Val-(2S,3S)-AHPBA-(Bzl)Gly-Val-Val-NH ₂	30.4	
25	H-Val-Val-(2R,3S)-AHPBA-(Bzl)Gly-Val-Val-NH ₂	2.3	
26	PhCH ₂ CH ₂ CO-Ser-(2R,3S)-AHPBA-Pro-Ile-Val-NH ₂	15.7	83.1
27	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Melle-Val-NH ₂		92.9
28	Boc-(2S,3S)-AHPBA-Pro-Ile-O-C ₆ H ₁₁	63.9	
29	Boc-(2R,3S)-AHPBA-Pro-Ile-O-C ₆ H ₁₁	88.3	
30	Boc-(2S,3S)-AHPBA-Pro-Ile-NH-CH ₂ -C ₆ H ₁₁	23.4	
31	Boc-(2R,3S)-AHPBA-Pro-Ile-NH-CH ₂ -C ₆ H ₁₁	47.4	
32	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-Ile-NH-CH ₂ -C ₆ H ₁₁		4.0
33	Boc-(2S,3S)-AHPBA-(cHexm)Gly-Ile-NH-CH ₂ -C ₆ H ₁₁	85.6	

Table 2

Example	Chemical Formula	Residual Activity (%)	
		1 mM	5 mM
34	Boc-(2R,3S)-AHPBA-(cHexm)Gly-Ile-NH-CH ₂ -C ₆ H ₁₁ -	87.8	
35	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-βAla-NH ₂	60.9	
36	PhCH ₂ CH ₂ CO-Gln-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	20.6	
37	PhCH ₂ CH ₂ CO-Asp(NMe ₂)-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	76.5	
38	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Val-Val-NH ₂	7.2	
39	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Leu-Val-NH ₂	48.2	
40	PhCH ₂ CH ₂ CO-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	74.2	
41	PhO-CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	1.2	
42	Pyridine-CO-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	6.4	
43	Quinoline-CO-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	0.8	
44	H-Ser-Phe-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	2.2	
45	H-Ser-Phe-Asn-(2R,3S)-AHPBA-Pro-Ile-Val-NH ₂	3.2	
46	Boc-Asn-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	51.9	
47	PhCH ₂ CH ₂ CO-Ser-Asn-(2S,3S)-AHPBA-NH-CH ₂ -C ₆ H ₁₁	13.2	
48	Boc-(2S,3S)-AHPBA-Pro-NH-CH ₂ -C ₆ H ₁₁	57.5	
49	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-CH ₂ -C ₆ H ₁₁	51.9	
50	Boc-(2S,3S)-AHPBA-Pro-Gln-NH-CH ₂ -C ₆ H ₁₁	62.9	
51	Boc-Asn-(2S,3S)-AHPBA-Pro-Ile-NH-iBu	85.3	
52	Boc-Val-(2R,3S)-AHPBA-Phe-Val-NH-iBu	94.6	
53	PhCH ₂ -O-CO-Val-(2R,3S)-AHPBA-Phe-Val-NH-iBu	83.4	
54	PhCH ₂ -O-CO-Val-(2R,3S)-AHPBA-Phe-NH-iBu	84.9	
55	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-tBu	3.5	
56	PhCH ₂ -O-CO-Asn-(2R,3S)-AHPBA-Pro-NH-tBu	95.1	
57	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-ACHBA-Pro-Ile-Val-NH ₂	25.7	
58	PhCH ₂ CH ₂ CO-Asn-(2R,3S)-ACHBA-Pro-Ile-Val-NH ₂	81.3	
59	PhCH ₂ CH ₂ CO-His-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	18.2	
60	PhCH ₂ CH ₂ CO-Ser(Me)-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	10.6	
61	PhCH ₂ CH ₂ CO-Smc(O)-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	90.9	
62	PhCH ₂ CH ₂ CO-Msa-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	3.2	
63	Fmoc-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	1.0	
64	1Nap-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	0.5	
65	Furan-CO-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	9.3	
66	Pyrazine-CO-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	6.2	
67	Thiophen-CO-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	4.9	
68	H-Inc-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	5.5	
69	H-(D)-Tic-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	29.0	

Table 3

Example	Chemical Formula	Residual Activity (%)	
		1 mM	5 mM
70	H-(L)-Tic-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂ -	3.4	
71	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA(OMe)-Pro-Ile-Val-NH ₂	95.5	
72	PhCH ₂ CH ₂ CO-Met(O) ₂ -(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂		96.8
73	PhCH ₂ CH ₂ CO-Ser-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	21.5	
74	PhCH ₂ CH ₂ CO-Leu-(2S,3S)-AHPBA-Pro-Ile-Val-NH ₂	31.3	
75	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Gln-Ile-NH ₂	62.0	
76	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Val-NH ₂	39.1	
77	PhCH ₂ CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-Ile-NH ₂	57.0	
78	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-(L)-Pip-NH-tBu	11.7	
79	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-(D)-Pip-NH-tBu	84.0	
80	Boc-Asn-(2S,3S)-AHPBA-Pro-NH-tBu	68.8	
81	1Nap-CH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-tBu	1.4	
82	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Thz-NH-tBu	1.3	
83	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-CH ₂ -C(Me) ₃	12.4	
84	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-C ₆ H ₁₁	9.6	
85	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-iPr	10.0	
86	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-O-tBu	12.6	
87	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-tAmyl	5.8	
88	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-cyclopropyl	<10	
89	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-CH(C ₂ H ₅) ₂	<10	
90	1Nap-CH ₂ -O-CO-Msa-(2S,3S)-AHPBA-Pro-NH-tBu	1.5	
91	1Nap-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-NH-tBu		20.5
92	Fmoc-Asn-(2S,3S)-AHPBA-Pro-NH-tBu		53.5

5 Table 4

Example	Chemical Formula	Residual Activity (%)	
		1 mM	5 mM
93	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-Aib-NH ₂	<10	37.0
94	(p-ClPh) ₂ CH-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Pro-NH-tBu		
95	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Hyp(Bzl)-NH-tBu	34.6	
96	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Inc-NH-tBu	95.2	
97	Boc-Sma-(2S,3S)-AHPBA-Pro-NH-tBu	92.9	
98	1Nap-O-CH ₂ CO-Sma-(2S,3S)-AHPBA-Pro-NH-tBu		70.5
99	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-C(Me) ₂ CH ₂ OH		62.2
100	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu		6.1
101	1Nap-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Thz-NH-tBu		8.7
102	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-(L)-Tic-NH-tBu		89.2
103	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-(D)-Tic-NH-tBu		91.4
104	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		3.8
105	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Dtc-NH-tBu		1.0
106	1Nap-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		1.1
107	1Nap-CH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		1.6
108	(E)-Ph-CH=CH-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		3.7
109	oCl-Ph-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		2.7
110	oPh-Ph-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		3.0
111	mPh-Ph-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		1.1
112	pPh-Ph-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		2.0
113	mCl-Ph-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		2.3
114	1Tna-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		2.1
115	5-Isoquinoline-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		2.4
116	m-(Ph-NH)-Ph-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		0.9
117	8Qoa-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		44.1
118	Quinoline-CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		1.8
119	1Nap-O-CH ₂ CO-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu		0.7
120	8Qoa-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu		9.5
121	1Nap-O-CH ₂ CO-Asn-Mta ⁺ (Me)-(2S,3S)-AHPBA-Dtc-NH-tBu · AcO ⁻		32.0
122	1Nap-O-CH ₂ CO-Mta-(2S,3S)-AHPBA-Pro-NH-tBu		6.9
123	1Nap-NH-CH ₂ CO-Msa-(2S,3S)-AHPBA-Pro-NH-tBu · AcOH		44.6
124	1Nap-NH-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu · AcOH		28.2
125	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-C(Me) ₂ CH ₂ OH		8.2

Table 5

Example	Chemical Formula	Residual Activity (%)	
		1 mM	5 mM
126	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Pro-NH-C(CH ₂ OH) ₂ Me		67.9
127	1Nap-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Thz-piperidine	<10	
128	1Nap-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Thz-NH-cyclopropyl		10.5
129	mPh-Ph-O-CH ₂ CO-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu		0.8
130	5-Isoquinoline-O-CH ₂ CO-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu · AcOH		0.9
131	2Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Pro-NH-tBu		28.8
132	1Nap-O-CH ₂ CO-Hse-(2S,3S)-AHPBA-Thz-NH-tBu		
133	1Nap-O-CH ₂ CO-Thr-(2S,3S)-AHPBA-Thz-NH-tBu		54.7
134	1Nap-O-CH ₂ CO-Tle-(2S,3S)-AHPBA-Thz-NH-tBu		22.6
135	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-CH(iPr)CH ₂ OH		19.3
136	Benzofuran-CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu		19.5
137	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-CH(sBu)CH ₂ OH	<10	
138	Quinoline-CO-Asn-(2S,3S)-AHPBA-Pro-NH-tBu		27.3
139	1Nap-CH ₂ -O-CO-Asp(NHNH ₂)-(2S,3S)-AHPBA-Pro-NH-tBu · AcOH		27.2
140	1-Isoquinoline-CO-Asn-(2S,3S)-AHPBA-Pro-NH-tBu · AcOH		72.8
141	1Nap-SO ₂ -Asn-(2S,3S)-AHPBA-Pro-NH-tBu		88.2
142	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-tAmyl		11.7
143	Biphenyl-CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu	<10	
144	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-3Dic-NH-tBu		95.9
145	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-1Dic-NH-tBu		96.6
146	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Oic-NH-tBu		97.5
147	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(o-OH)		96.7
148	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(m-OH)		88.9
149	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(p-OH)	<10	
150	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Hyp-NH-tBu		31.6
151	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Hyp(Me)-NH-tBu		74.8
152	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Hyp(Et)-NH-tBu		91.2
153	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Hyp(Allyl)-NH-tBu		70.6
154	1Nap-O-CH ₂ CO-Mtv-(2S,3S)-AHPBA-Thz-NH-tBu		35.4
155	1Nap-O-CH ₂ CO-Msv-(2S,3S)-AHPBA-Thz-NH-tBu		7.3

Table 6

Example	Chemical Formula	Residual Activity (%)	
		1 mM	5 mM
156	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-CH(Ph)CH ₂ OH		94.5
157	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-Phg-NH ₂		93.9
158	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-chex-ol		<10
159	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-Pip-OMe		90.8
160	1Nap-O-CH ₂ CO-Phg-(2S,3S)-AHPBA-Thz-NH-tBu		54.8
161	1Nap-O-CH ₂ CO-Ile-(2S,3S)-AHPBA-Thz-NH-tBu		7.0
162	1Nap-O-CH ₂ CO-Mta-(2S,3S)-AHPBA-Thz-NH-tBu		2.9
163	1Nap-O-CH ₂ CO-Thr(Me)-(2S,3S)-AHPBA-Thz-NH-tBu		5.7
164	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pdp-NH-tBu		49.8
165	1Nap-O-CH ₂ CO-Nva-(2S,3S)-AHPBA-Thz-NH-tBu		10.7
166	m-(iPr-O)-Ph-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Dtc-NH-tBu		2.0
167	m-(Piper-CO)-Ph-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu		25.4
168	m-(Morph-CO)-Ph-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu		44.5
169	m-(iPr-O)-Ph-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		1.4
170	1Nap-O-CH ₂ CO-Alg-(2S,3S)-AHPBA-Thz-NH-tBu		7.3
171	2,3-diMe-Ph-O-CH ₂ CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu		2.9
172	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-Gly-NH ₂		77.9
173	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-GABA-NH ₂		65.0
174	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-BAIB-NH ₂		46.6
175	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Thz-BANB-NH ₂		33.0
176	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Pro-NH-sBu		82.6
177	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Dtc-NH ₂		74.2
178	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Diq		8.6
179	1Nap-O-CH ₂ CO-Val-(2S,3S)-AHPBA-Thz-NH-tBu		5.5
180	1Nap-O-CH ₂ CO-Prg-(2S,3S)-AHPBA-Thz-NH-tBu		26.0
181	1Nap-O-CH ₂ CO-Aca-(2S,3S)-AHPBA-Thz-NH-tBu		73.0
182	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Dmp-NH-tBu		26.8
183	1Nap-O-CH ₂ CO-Msa-(2S,3S)-AHPBA-Dmp-NH-tBu		4.3
184	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Php-NH-tBu		16.8
185	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Cpp-NH-tBu		96.0
186	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Tcp-NH-tBu		99.5
187	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Ccp-NH-tBu		99.0
188	PhCH ₂ -O-CO-Asn-(2S,3S)-AHPBA-Dmp-NH ₂		98.1

The compounds represented by the general formula (9) and pharmaceutically acceptable salts thereof can be prepared as HIV protease inhibitors by conventional methods with conventional carriers and fillers. For example, tablets, capsules and granules are orally administered and injection preparations are administered intravenously or intramuscularly. Furthermore, adhesive plasters, suppositories, sprays are used topically.

More specifically, the compounds of the invention can be administered by topical, intravenous, intraperitoneal, oral, and subcutaneous administration. The compounds of the invention may be administered to a

domestic animal or to an animal such as a mammal (e.g. mouse, rat or human).

The compounds of the present invention can be made into pharmaceutical compositions by combination with appropriate medical carriers or diluents. For example, the compounds of the present invention can be dissolved in oils, propylene-glycol or other solvents commonly used to prepare injectable solutions. Suitable carriers include physiological saline, polyethylene glycol, ethanol, sesame oil, cremophor and isopropyl myristate. For topical application, the compounds of the invention can be formulated as an ointment or cream.

In terms of composition, compounds should be present between 0.1 to 100%, preferably 1 to 90% based on the total weight of the composition.

The following methods and excipients are merely exemplary and in no way limit the invention.

The compounds of the present invention in pharmaceutical dosage forms may be used in the form of their pharmaceutically acceptable salts, and also may be used alone or in appropriate association, as well as in combination with other pharmaceutically active compounds.

The compounds of the present invention may be formulated into preparations for injections by dissolving, suspending, or emulsifying them in aqueous solvents such as normal saline, Dextrose 5%, or non-aqueous solvent, such as vegetable oil, synthetic aliphatic acid glycerides, esters of higher aliphatic acids or propylene glycol; and if desired, with conventional additives such as solubilizers, isotonic agents, suspending agents, emulsifying agents, stabilizers and preservatives.

The compounds of the invention may be combined with other compounds having the desired effect.

The dosage may be suitably determined according to the symptoms; ages and sexes of the patients, and doses of 0.001-5 g per person in a day are generally used for adults in 1-5 divided portions. One of preferable administration is a method of absorbing through the nasal membrane by a nasal spray. In this case, a compound represented by the general formula (9) is dissolved in fluorocarbon or saline solution together with preservatives such as benzyl alcohol and absorption accelerating agent for the improved bioavailability and the resultant formulation can be administered by nasal aerosol or inhalation.

The peptide derivatives of the present invention represented by the general formula (9) and pharmaceutically acceptable salts thereof are presumed to have no acute toxicity.

The HIV protease inhibitors of the present invention markedly inhibit the HIV protease activity. In addition, they are stable against proteolytic enzymes due to their amino acid isostere. Therefore, the HIV protease inhibitors of the present invention are expected to be useful for the therapy of acquired immunodeficiency syndrome (AIDS) and prevention of HIV infection.

The invention will be explained in detail by the following examples:

EXAMPLES

Ref. Example: (2RS, 3S)-3-N-(t-butoxycarbonyl)amino-2-hydroxy-4-phenylbutanoic acid

In 15 ml of purified water, 1.49 g of hydrochloride of (2RS,3S)-3-amino-2-hydroxy-4-phenylbutanoic acid (hereinafter, the amino acid residue thereof is abbreviated as -AHPBA-) was suspended, 1.75 ml of triethylamine was added under ice cooling, then 2.20 g of di-tert-butyl dicarbonate (Boc_2O) in 15 ml of tetrahydrofuran (THF) was added, and the resultant mixture was stirred for 14 hr. The reaction mixture was washed with ether and the aqueous layer was condensed to the half volume. The condensate was adjusted to pH 2-3 with citric acid, extracted with ethyl acetate, washed with saturated sodium chloride aqueous solution and dried over anhydrous sodium sulfate. The dried solution was condensed under reduced pressure and hexane was added to the residue to give 1.86 g of crystals of Boc-(2RS,3S)-AHPBA-OH.

Example 1-8

[Process 1] H-AHPBA-NH-CH₂-C₆H₁₁.HCl

To a solution of 300 mg (1.15 mmol) of Boc-AHPBA-OH in 2.0 ml of N,N-dimethylformamide (DMF), and 162 μl (1.15 mmol) of cyclohexylmethylamine, 204 mg (1.15 mmol) of N-hydroxy-norbornene-2,3-dicarboximide (HONB) and 336 mg (1.73 mmol) of 1-ethyl-3-(3-N,N-dimethylaminopropyl)carbodiimide (EDC) hydrochloride were added, and the mixture was stirred for 14 hr. The reaction mixture was condensed and the residue was dissolved in ethyl acetate and washed successively with 1N-HCl, 5% aqueous solution of sodium hydrogencarbonate and saturated aqueous sodium chloride solution. The washed solution was dried over anhydrous sodium sulfate. The dried solution was evaporated to dryness under reduced pressure, mixed with 8.65 ml (34.59 mmol) of 4N-HCl dioxane solution under ice cooling and stirred for 60 min. The reaction mixture was condensed and ether was added to the residue to give precipitates. The precipitates were collected and

purified using a silica gel column chromatography with CHCl_3 :MeOH and treated with 4N-HCl dioxane solution to give the title compound (2R,3S: 181 mg, 2S,3S: 132 mg).

[Process 2] Boc-Phe-Asn-OH

In a solution of 10 ml of DMF containing 500 mg (1.38 mmol) of Boc-Phe-succinimide ester (Boc-Phe-OSu), 5 ml of aqueous solution of H-Asn-OH. Et_3N [prepared from 365 mg (2.76 mmol) of H-Asn-OH and 384 μl (2.76 mmol) of Et_3N] was added under ice cooling and the mixture was stirred for 14 hr. The reaction mixture was evaporated under reduced pressure and the residue was dissolved in ethyl acetate, washed with 1N-HCl and saturated sodium chloride aqueous solution, dried over anhydrous sodium sulfate. The dried solution was condensed under reduced pressure and the oily residue was triturated with ether to give 364 mg of crystals of the title compound with a yield of 70%.

[Process 3] Boc-Phe-Ser-OH

In a 10 ml solution of DMF containing 500 mg (1.38 mmol) of Boc-Phe-OSu was added 5 ml of an aqueous solution of H-Ser-OH. Et_3N [prepared from 290 mg (2.76 mmol) of H-Ser-OH and 384 μl (2.76 mmol) of Et_3N] and the mixture was stirred for 14 hr. The reaction mixture was evaporated and the residue was dissolved in ethyl acetate and washed with 1N-HCl and saturated sodium chloride aqueous solution, successively, together with salting out. The resultant solution was dried over anhydrous sodium sulfate, evaporated under reduced pressure, and the resulted residue was purified with a silica gel column chromatography (CHCl_3 :MeOH). The eluate was mixed with ether and n-hexane to give crystals of 150 mg of the title compound with a yield of 31%.

[Process 4] Compound of Example 1-8

In a 2.0 ml solution of DMF containing 20 mg (0.065 mmol) of H-AHPBA-NH- CH_2 - C_6H_{11} hydrochloride obtained by the process 1 were added 9.0 μl (0.065 mmol) of Et_3N , 0.065 mmol of an amino acid or a peptide derivative (Boc-Asn-OH: 15.0 mg, Boc-Ser-OH: 13.3 mg, Boc-Phe-Asn-OH: 24.6 mg or Boc-Phe-Ser-OH: 22.8 mg), 11.6 mg (0.065 mmol) of HONB and 18.6 mg (0.097 mmol) of EDC.HCl, successively, and the resultant mixture was stirred for 14 hr. The reaction mixture was evaporated and purified by the following method (a) or (b). The used natural amino acids were L-form except otherwise stated and so forth.

(a) The residue was dissolved in ethyl acetate, washed with 1N-HCl and saturated aqueous sodium chloride solution, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure, purified with a silica gel column chromatography (CHCl_3 :MeOH) and crystallized from ether or n-hexane.

(b) The residue was mixed with water, the formed precipitates were collected by filtration, dried, purified with a silica gel column chromatography (CHCl_3 :MeOH), and crystallized from ether.

Example 9-15

The compound obtained in Example 1-8 (Process 4) was stirred in 2-3 ml of 4N-HCl in dioxane at room temperature for 60 min, respectively. The reaction mixture was evaporated under reduced pressure, ether was added to the residue and the formed precipitates were collected by centrifugation. The resultant precipitates were dissolved in 1N-acetic acid, purified with a reversed-phase column chromatography and lyophilized to give powders of compounds of Example 9-15, respectively.

Example 16: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

[Process 1] Diastereomeric separation of Boc-(2RS,3S)-AHPBA-O-benzyl

In 20 ml of DMF, 2.10 g of Boc-(2RS,3S)-AHPBA-OH obtained by the reference Example was dissolved. To the resultant solution were added under ice cooling 1.12 ml of dicyclohexylamine (DCHA) and 1.02 ml of benzyl bromide, successively, and the obtained mixture was stirred for 14 hr. The reaction mixture was filtered and the filtrate was evaporated under reduced pressure. The residue was dissolved in ethyl acetate, washed with 5% aqueous citric acid solution, 5% aqueous sodium hydrogen carbonate solution and saturated aqueous sodium chloride solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and the residue was subjected to a flash chromatography using 100 g of silica gel column and eluted with CHCl_3 to give 0.87 g of (2R,3S)-Boc-AHPBA-O-benzyl and 1.20 g of the (2S,3S)-

isomer TLC: Rf 0.63 for (2R,3S) (chloroform : methanol = 60:1) TLC: Rf 0.41 for (2S,3S) (chloroform : methanol = 60:1)

[Process 2] Debenzylation

In 10 ml of ethanol, 1.03 g of Boc-(2S,3S)-AHPBA-O-benzyl obtained by the process 1 was dissolved, hydrogen gas was introduced in the presence of 0.10 g of 10% palladium on charcoal and stirred for 60 min. The reaction mixture was filtered, the resultant filtrate was evaporated and crystallized by the addition of hexane to give 0.78 g of Boc-(2S,3S)-AHPBA-OH. Boc-(2R,3S)-AHPBA-OH was obtained from Boc-(2R,3S)-AHPBA-O-benzyl by a similar method.

[Process 3] 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

Protected amino acids, Boc-Val-OH, Boc-Ile-OH, Boc-Pro-OH, Boc-(2S,3S)-AHPBA-OH and Boc-Asn-OH, and 3-phenylpropionic acid were successively condensed by a solid phase peptide synthetic method [see Peptide Chemistry, 1988, 123 (1989)] using p-methylbenzhydrylamine resin. The resultant protected peptide resin was treated with anhydrous hydrogen fluoride under ice cooling for 60 min in the presence of m-cresol. The hydrogen fluoride was removed, ether was added, the formed precipitates were extracted with 50% aqueous acetic acid solution and the resultant extract was lyophilized. The lyophilized dried powder was dissolved in a mixture of 50% aqueous acetic acid and methanol and the obtained solution was subjected to a reversed-phase HPLC (water-acetonitrile system except otherwise stated and so forth). The fractionated eluate was evaporated and lyophilized to give the title compound.

Analytical HPLC: 23.9 min (The condition was as follows)

Column: YMC AM-302 (4.6 x 150 mm)

Solvent A: 0.1% trifluoroacetic acid aqueous solution

Solvent B: acetonitrile

Gradient: 10% B for 2 min, then B was increased in 1.67%/min

Flow rate: 0.7 ml/min

FAB-MS: 750 (M+1)

Example 17: 3-Phenylpropionyl-Asn-(2R,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).

Analytical HPLC: 25.3 min (For the condition, see Example 16.)

FAB-MS: 750 (M+1)

Example 18: H-Val-Val-(2R,3S)-AHPBA-Phe-Val-Val-NH₂

Example 19: H-Val-Val-(2S,3S)-AHPBA-Phe-Val-Val-NH₂

The title compounds were obtained by a solid phase method similar to Example 16 (Process 3) using the protected amino acid, (2RS,3S)-AHPBA-OH. Compounds (2R,3S) and (2S,3S) were divided during reversed-phase HPLC fractionation.

Analytical HPLC (2R,3S): 20.5 min (For the condition, see: Example 16.)

Analytical HPLC (2S,3S): 21.5 min (For the condition, see: Example 16.)

FAB-MS: 738 (M+1)

Example 20: Phenylacetyl-Ser-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

Example 21: Phenylacetyl-Ser-(2R,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compounds were obtained by a solid phase method similar to Example 16 (Process 3). Compounds (2R,3S) and (2S,3S) were divided during reversed-phase HPLC fractionation.

Analytical HPLC (2R,3S): 21.97 min (For the condition, see: Example 16.)

Analytical HPLC (2S,3S): 20.49 min (For the condition, see: Example 16.)

FAB-MS: 709 (M+1)

Example 22: H-Val-Val-(2S,3S)-AHPBA-(D)-Phe-(D)-Val-(D)-Val-NH₂

Example 23: H-Val-Val-(2R,3S)-AHPBA-(D)-Phe-(D)-Val-(D)-Val-NH₂

5 The title compounds were obtained by a solid phase method similar to Example 16 (Process 3). Compounds (2R,3S) and (2S,3S) were divided during reversed-phase HPLC fractionation.
Analytical HPLC (2R,3S): 20.48 min (For the condition, see: Example 16.)
Analytical HPLC (2S,3S): 20.98 min (For the condition, see: Example 16.)
FAB-MS: 738 (M+1)

10 Example 24: H-Val-Val-(2S,3S)-AHPBA-(Bzl)Gly-Val-Val-NH₂

Example 25: H-Val-Val-(2R,3S)-AHPBA-(Bzl)Gly-Val-Val-NH₂

15 The title compounds were obtained by a solid phase method similar to Example 16 (Process 3). Compounds (2R,3S) and (2S,3S) were divided during reversed-phase HPLC fractionation.
Analytical HPLC (2R,3S): 23.09 min (For the condition, see: Example 16.)
Analytical HPLC (2S,3S): 23.45 min (For the condition, see: Example 16.)
FAB-MS: 738 (M+1)

20 Example 26: 3-Phenylpropionyl-Ser-(2R,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 25.96 min (For the condition, see: Example 16.)
25 FAB-MS: 723 (M+1)

Example 27: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Melle-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
30 Analytical HPLC: 16.85 min (For the condition, see: Example 16.)
FAB-MS: 764 (M+1)

Example 28: Boc-(2S,3S)-AHPBA-Pro-Ile-O-C₆H₁₁

35 Example 29: Boc-(2R,3S)-AHPBA-Pro-Ile-O-C₆H₁₁

[Process 1] pMZ-Ile-O-C₆H₁₁

40 In a methylene chloride solution of 1.00 g of N-(p-methoxybenzyloxycarbonyl)isoleucine (pMZ-Ile-OH), 0.35 ml of cyclohexanol and 0.84 g of N,N-dicyclohexylcarbodiimide (DCC) were added in the presence of 4 mg of dimethylaminopyridine and the resultant mixture was stirred for 2 hr under ice cooling. The reaction mixture was filtered and the filtrate was washed with 5% citric acid aqueous solution, 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and the residue was subjected to
45 a silica gel column chromatography (chloroform) to give 1.01 g of pMZ-Ile-O-C₆H₁₁.
TLC: R_f 0.56 (chloroform)

[Process 2] Boc-Pro-Ile-O-C₆H₁₁

50 To 207 mg of the protected amino acid obtained by the [process 1], 4 ml of 4N-HCl in dioxane was added in the presence of 100 μ l of anisole and the resultant mixture was stirred for 60 min. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in 4 ml of DMF and neutralized with 76 μ l of triethylamine under ice cooling. To the neutralized solution, 118 mg of Boc-Pro-OH, 84 mg of N-hydroxybenzotriazol (HOBt) and 126 mg of EDC hydrochloride were added and the obtained mixture was stirred
55 for 14 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in ethyl acetate. The ethyl acetate solution was washed with 5% citric acid aqueous solution, 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and the residue

was subjected to a silica gel column chromatography (chloroform) to give 130 mg of the title compound.
TLC: Rf 0.61 (chloroform : methanol = 60:1)

[Process 3] Boc-(2S,3S)-AHPBA-Pro-Ile-O-C₆H₁₁ and Boc-(2R,3S)-AHPBA-Pro-Ile-O-C₆H₁₁

To 130 mg of the protected peptide obtained by the process 2, 2 ml of 4N-HCl in dioxane was added and the resultant mixture was stirred for 60 min at room temperature. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in 2 ml of DMF and neutralized with 44 μ l of triethylamine under ice cooling. To the neutralized solution, 94 mg of Boc-(2RS,3S)-AHPBA-OH, 140 mg of benzotriazol-1-yloxy tris(N,N-dimethylamino-phosphonium) hexafluorophosphate [Bop reagent] and 88 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in the process 2, except for the chromatography solvent (chloroform : methanol = 50:1), to give 54 mg of Boc-(2R,3S)-AHPBA-Pro-Ile-O-C₆H₁₁ and 58 mg of Boc-(2S,3S)-AHPBA-Pro-Ile-O-C₆H₁₁.
TLC: Rf 0.78, 0.46 (chloroform : methanol = 60:1)

FAB-MS: 588 (M+1)

Example 30: Boc-(2S,3S)-AHPBA-Pro-Ile-NH-CH₂-C₆H₁₁

[Process 1] pMZ-Ile-NH-CH₂-C₆H₁₁

In a 10 ml of DMF solution containing 1.00 g. of HONB ester of pMZ-isoleucine, 0.28 ml of cyclohexylmethylamine and 0.27 ml of N-methylmorpholine were added under ice cooling and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure, purified water was added to the residue, the formed precipitates were collected and reprecipitated from DMF and ether to give 0.64 g of the title compound.

TLC: Rf 0.63 (chloroform : methanol = 40:1)

[Process 2] H-Ile-NH-CH₂-C₆H₁₁

In 2 ml of trifluoroacetic acid, 0.50 g of the product obtained by the process 1 was added in the presence of 0.25 ml of anisole under ice cooling and stirred for 60 min. The reaction mixture was evaporated under reduced pressure, redissolved in 5 ml of DMF and neutralized by the addition of triethylamine under ice cooling to prepare a solution of the title compound.

[Process 3] Boc-Pro-Ile-NH-CH₂-C₆H₁₁

In a solution prepared of 0.33 g of Boc-Pro-OH and 2 ml of DMF, 0.23 ml of triethylamine and 0.22 ml of isobutyl chloroformate were added at -15 °C and stirred for 10 min. The reaction solution was added to the entire solution prepared by the process 2 and the resultant mixture was stirred for 60 min. The reaction mixture was treated similarly to that in Example 28 (Process 1) and recrystallized from hexane to give the title compound.
TLC : Rf 0.38 (chloroform : methanol = 20:1)

[Process 4] Boc-(2S,3S)-AHPBA-Pro-Ile-NH-CH₂-C₆H₁₁

Deprotection of 50 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 17 μ l of triethylamine under ice cooling. To the neutralized solution, 35 mg of Boc-(2S,3S)-AHPBA-OH, 52 mg of Bop reagent and 34 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2), except for the chromatography solvent (chloroform : methanol = 30:1), to give 68 mg of the title compound.

TLC: Rf 0.41 (chloroform : methanol = 20:1)

Example 31: Boc-(2R,3S)-AHPBA-Pro-Ile-NH-CH₂-C₆H₁₁

The title compound was synthesized by a similar method of Example 30.

TLC: Rf 0.57 (chloroform : methanol = 20:1)

FAB-MS: 601 (M+1)

Example 32: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-Ile-NH-CH₂-C₆H₁₁

Deprotection of 68 mg of the compound obtained by Example 30 (Process 4) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 4 ml of DMF and neutralized with 16 μ l of triethylamine under ice cooling. To the neutralized solution, 30 mg of N-(benzyloxycarbonyl)asparagine, 17 mg of HOBt, 50 mg of Bop reagent and 39 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 30 (Process 4) to give 30 mg of the title compound.

TLC: Rf 0.40 (chloroform : methanol = 9:1)

FAB-MS: 749 (M+1)

Example 33: Boc-(2S,3S)-AHPBA-(cHexm)Gly-Ile-NH-CH₂-C₆H₁₁

Example 34: Boc-(2R,3S)-AHPBA-(cHexm)Gly-Ile-NH-CH₂-C₆H₁₁

[Process 1] Boc-(cHexm)Gly-OH cyclohexylamine salt

In a methanol solution containing 2.0 g of H-Gly-OMe.HCl, 2.12 ml of cyclohexanecarboxaldehyde was added and the resultant mixture was stirred overnight in H₂ atmosphere in the presence of 200 mg of 10% palladium-charcoal. The reaction mixture was filtered and the filtrate was evaporated under reduced pressure to give N-(cyclohexylmethyl)glycine methyl ester [H-(cHexm)Gly-OMe]. The CHCl₃ solution of the amino ester obtained above was mixed with 3.32 ml of triethylamine and 4.18 g of Boc₂O under ice cooling and the mixture was stirred for 3 hr. The stirred mixture was washed with 5% aqueous citric acid solution, 5% aqueous sodium hydrogencarbonate solution, and saturated aqueous sodium chloride solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure. The residue was subjected to a silica gel column chromatography (chloroform) to give oily Boc-(cHexm)Gly-OMe. The oily product was dissolved in methanol and 11.4 ml of 1N-NaOH aqueous solution was added and the resultant solution was stirred for 2 hr at room temperature. The obtained solution was neutralized with citric acid, evaporated and dissolved in ethyl acetate. The ethyl acetate solution was washed with 5% aqueous citric acid solution and saturated aqueous sodium chloride solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure. The residue was dissolved in methanol and cyclohexylamine was added to the solution, then the resultant solution was evaporated and crystallized from ether to give 1.75 g of the title compound.

TLC: Rf 0.71 (chloroform : methanol:acetic acid = 9:1:0.5)

[Process 2] Boc-(cHexm)Gly-Ile-NH-CH₂-C₆H₁₁

Deprotection of 100 mg of the compound obtained by Example 30 (Process 1) was performed similarly to that in Example 28 (Process 3) in the presence of 50 μ l of anisol, and the obtained product was dissolved in 5 ml of DMF and neutralized with 36 μ l of triethylamine under ice cooling. To the neutralized solution, Boc-(cHexm)Gly-OH obtained from 114 mg of the compound obtained by the process 1, 39 mg of HOBt and 59 mg of EDC hydrochloride were added and the obtained mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2) to give 115 mg of the title compound.

[Process 3] Boc-(2S,3S)-AHPBA-(cHexm)Gly-Ile-NH-CH₂-C₆H₁₁ and Boc-(2R,3S)-AHPBA-(cHexm)Gly-Ile-NH-CH₂-C₆H₁₁

Deprotection of 50 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 14 μ l of triethylamine under ice cooling. To the neutralized solution, 31 mg of Boc-(2RS,3S)-AHPBA-OH, 46 mg of Bop reagent and 28 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2), except for the chromatography solvent (chloroform : methanol = 100:1), to give 20.3 mg of Boc-(2S,3S)-AHPBA-(cHexm)Gly-Ile-NH-CH₂-C₆H₁₁ and 9.8 mg of Boc-(2R,3S)-AHPBA-(cHexm)Gly-Ile-NH-CH₂-C₆H₁₁.

TLC: Rf 0.61, 0.46 (chloroform : methanol = 20:1)

FAB-MS: 657 (M+1)

Example 35: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-β Ala-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 12.33 min (The condition was as follows) Column: YMC AM-302 (4.6 x 150 mm)
 Solvent A: 0.1% trifluoroacetic acid aqueous solution
 Solvent B: acetonitrile
 Gradient: 20% B for 2 min, then B was increased in 2% /min
 Flow rate: 0.7 ml/min
 FAB-MS: 609 (M+1)

Example 36: 3-Phenylpropionyl-Gln-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 16.68 min (For the condition, see: Example 35)
 FAB-MS: 764 (M+1)

Example 37: 3-Phenylpropionyl-Asp(NMe₂)-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 18.88 min (For the condition, see: Example 35)
 FAB-MS: 778 (M+1)

Example 38: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Val-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 15.97 min (For the condition, see: Example 35)
 FAB-MS: 736 (M+1)

Example 39: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Leu-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: : 17.68 min (For the condition, see: Example 35)
 FAB-MS: 750 (M+1)

Example 40: 3-Phenylpropionyl-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 21.84 min (For the condition, see: Example 35)
 FAB-MS: 636 (M+1)

Example 41: Phenoxyacetyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 16.57 min (For the condition, see: Example 35)
 FAB-MS: 752 (M+1)

Example 42: 2-Pyridinecarbonyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 13.64 min (For the condition, see: Example 35)
 FAB-MS: 723 (M+1)

Example 43: 2-Quinolinecarbonyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 17.81 min (For the condition, see: Example 35)
 FAB-MS: 773 (M+1)

Example 44: H-Ser-Phe-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 19.13 min (For the condition, see: Example 16)

5 FAB-MS: 852 (M+1)

Example 45: H-Ser-Phe-Asn-(2R,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
10 Analytical HPLC: 21.54 min (For the condition, see: Example 16)

FAB-MS: 852 (M+1)

Example 46: Boc-Asn-(2S,3S)-AHPBA-Pro-Ile-NH-CH₂-C₆H₁₁

15 Deprotection of 81 mg of the compound obtained by Example 30 (Process 4) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 17 μ l of triethylamine under ice cooling. To the neutralized solution, 33 mg of Boc-Asn-OH, 22 mg of HOBt and 41 mg of EDC hydrochloride were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2), except for the chromatography solvent (chloroform :
20 methanol = 20:1) to give 41 mg of the title compound.

TLC: Rf 0.36 (chloroform : methanol = 9:1)

Example 47: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Ile-NH-CH₂-C₆H₁₁

25 Deprotection of 33 mg of the compound obtained by Example 46 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 4 ml of DMF and neutralized with 6 μ l of triethylamine under ice cooling. To the neutralized solution, 7 mg of phenylpropionic acid, 20 mg of Bop reagent and 13 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 to give 6 mg of the title compound.

30 TLC: Rf 0.82 (chloroform : methanol = 9:1)

Analytical HPLC: 24.50 min (For the condition, see Example 16)

FAB-MS: 747 (M+1)

Example 48: Boc-(2S,3S)-AHPBA-Pro-NH-CH₂-C₆H₁₁

35 [Process 1] Boc-Pro-NH-CH₂-C₆H₁₁

In a DMF solution containing 1.0 g of Boc-Pro-OH, 0.6 ml of cyclohexylmethylamine, 0.83 g of HOBt and 1.07 g of EDC hydrochloride were added under ice cooling, and the resultant mixture was stirred for 14 hr. The
40 reaction mixture was treated similarly to that in Example 46 to give the title compound.

TLC: Rf = 0.77 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-Pro-NH-CH₂-C₆H₁₁

45 Deprotection of 50 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 22 μ l of triethylamine under ice cooling. To the neutralized solution, 48 mg of Boc-(2S,3S)-AHPBA-OH, 71 mg of Bop reagent and 45 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 to give 62 mg of the title compound.

50 TLC: Rf 0.57 (chloroform : methanol = 9:1)

Example 49: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-NH-CH₂-C₆H₁₁

55 Deprotection of 62 mg of the compound obtained by Example 48 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 18 μ l of triethylamine under ice cooling. To the neutralized solution, 98 mg of p-nitrophenyl ester of benzyloxycarbonyl-Asn-OH [benzyloxycarbonyl-Asn-ONp], 39 mg of HOBt and 28 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 46, except

for the chromatography solvent (chloroform : methanol = 10:1), and crystallized from ether to give 49 mg of the title compound.

TLC: Rf 0.41 (chloroform : methanol = 9:1)

FAB-MS: 636 (M+1)

5

Example 50: Boc-(2S,3S)-AHPBA-Pro-Gln-NH-CH₂-C₆H₁₁

[Process 1] pMZ-Gln-NH-CH₂-C₆H₁₁

10

In a DMF solution containing 1.0 g of pMZ-Gln-ONp, 0.3 ml of cyclohexylmethylamine and 0.35 ml of triethylamine were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was evaporated under reduced pressure and water was added to the resultant residue to give a solid mass. The solid mass was reprecipitated from DMF/ethyl acetate to give 0.71 g of the title compound.

TLC: Rf 0.52 (chloroform : methanol:H₂O = 8:3:1, lower layer)

15

[Process 2] Boc-Pro-Gln-NH-CH₂-C₆H₁₁

Deprotection of 710 mg of the compound obtained by the process 1 was performed similarly to that in Exmpl 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with triethylamine under ice cooling. To the neutralized solution, a mixed anhydride prepared from 452 mg of Boc-Pro-OH, 321 μ l of triethylamine and 300 μ l of isobutyl chloroformate was added and the resultant mixture was stirred for 1 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in ethyl acetate. The ethyl acetate solution was washed with 5% citric acid aqueous solution, 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and the residue was crystallized from ether to give 550 mg of the title compound.

TLC: Rf 0.57 (chloroform : methanol:H₂O = 8:3:1, lower layer)

[Process 3] Boc-(2S,3S)-AHPBA-Pro-Gln-NH-CH₂-C₆H₁₁

30

Deprotection of 100 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 2 ml of DMF and neutralized with 32 μ l of triethylamine under ice cooling. To the neutralized solution, 67 mg of Boc-(2S,3S)-AHPBA-OH, 101 mg of Bop reagent, and 64 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 to give 73 mg of the title compound.

FAB-MS: 616 (M+1)

Example 51: Boc-Asn-(2S,3S)-AHPBA-Pro-Ile-NH-CH₂-CH(CH₃)₂

[Process 1] Boc-Ile-NH-CH₂-CH(CH₃)₂

40

In a DMF solution containing 2.0 g of Boc-Ile-OH, 0.82 ml of isobutylamine, 1.27 g of HOBt and 2.06 g of DCC were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture, after filtration, was treated similarly to that in Example 50 (Process 2), except for the crystallization solvent (hexane) to give 1.44 g of the title compound.

45

[Process 2] Boc-Pro-Ile-NH-CH₂-CH(CH₃)₂

Deprotection of 1.44 g of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with triethylamine under ice cooling. To the neutralized solution, 1.10 g of Boc-Pro-OH, 0.77 g of HOBt and 1.25 g of DCC were added and the resultant mixture was stirred for 14 hr. The reaction mixture was filtered and the filtrate was evaporated under reduced pressure and redissolved in ethyl acetate. The ethyl acetate solution was washed with 5% citric acid aqueous solution, 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure to give 1.00 g of the title compound.

55

[Process 3] Boc-(2S,3S)-AHPBA-Pro-Ile-NH-CH₂-CH(CH₃)₂

Deprotection of 50 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 2 ml of DMF and neutralized with 18 μ l of triethylamine under ice cooling. To the neutralized solution, 38 mg of Boc-(2S,3S)-AHPBA-OH, 57 mg of Bop reagent, and 36 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 to give 57 mg of the title compound.

TLC: Rf 0.77 (chloroform : methanol = 9:1)

[Process 4] Boc-Asn(2S,3S)-AHPBA-Pro-Ile-NH-CH₂-CH(CH₃)₂

Deprotection of 51 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 13 μ l of triethylamine under ice cooling. To the neutralized solution, 64 mg of p-nitrophenyl ester of Boc-Asn-OH, 14 mg of HOBt and 20 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 50 (Process 2) to give 45 mg of the title compound.

TLC: Rf 0.39 (chloroform : methanol = 9:1)

FAB-MS: 675 (M+1)

Example 52: Boc-Val-(2R,3S)-AHPBA-Phe-Val-NH-CH₂-CH(CH₃)₂[Process 1] Boc-Val-NH-CH₂-CH(CH₃)₂

In a DMF solution containing 2.0 g of Boc-Val-OH, 0.92 ml of isobutylamine, 1.40 g of HOBt and 2.28 g of DCC were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 51 (Process 1) to give 1.89 g of the title compound.

[Process 2] Boc-Phe-Val-NH-CH₂-CH(CH₃)₂

Deprotection of 1.89 g of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with triethylamine under ice cooling. To the neutralized solution, 1.85 g of Boc-Phe-OH, 1.06 g of HOBt and 1.72 g of DCC were added and the resultant mixture was stirred for 14 hr. The reaction mixture was filtered and the filtrate was evaporated under reduced pressure and water was added to the residue to give a solid mass. The mass was washed with water and reprecipitated from THF-ether to give 2.20 g of the title compound.

[Process 3] Boc-(2R,3S)-AHPBA-Phe-Val-NH-CH₂-CH(CH₃)₂

Deprotection of 300 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 10 ml of DMF and neutralized with 99 μ l of triethylamine under ice cooling. To the neutralized solution, 211 mg of Boc-(2R,3S)-AHPBA-OH, 316 mg of Bop reagent, and 198 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 30 (Process 4) to give 94 mg the title compound.

TLC: Rf 0.41 (chloroform : methanol = 9:1)

[Process 4] Boc-Val-(2R,3S)-AHPBA-Phe-Val-NH-CH₂-CH(CH₃)₂

Deprotection of 30 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 7 μ l of triethylamine under ice cooling. To the neutralized solution, 11 mg of Boc-Val-OH, 22 mg of Bop reagent and 14 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 50 (Process 2) and the obtained precipitates were reprecipitated from DMF-ether to give 17 mg of the title compound.

TLC: Rf 0.88 (chloroform : methanol = 9:1)

FAB-MS: 696 (M+1)

Example 53: Benzyloxycarbonyl-Val-(2R,3S)-AHPBA-Phe-Val-NH-CH₂-CH(CH₃)₂

Deprotection of 30 mg of the compound obtained by Example 52 (Process 3) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 7 μ l of triethylamine under ice cooling. To the neutralized solution, 21 mg of benzyloxycarbonyl-Val-OH.DCHA, 22 mg of Bop reagent and 7 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and water was added to the resultant residue to give precipitates. The precipitates were washed with water and reprecipitated from THF-ether to give 6 mg of the title compound.

TLC: Rf 0.88 (chloroform : methanol = 20:1)

FAB-MS: 730 (M+1)

Example 54: Benzyloxycarbonyl-Val-(2R,3S)-AHPBA-Phe-NH-CH₂-CH(CH₃)₂[Process 1] Boc-Phe-NH-CH₂-CH(CH₃)₂

In a DMF solution containing a mixed anhydride prepared from 2.0 g of Boc-Phe-OH, 1.15 ml of triethylamine and 1.08 ml of isobutyl chloroformate, 1.50 ml of isobutylamine was added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 51 (Process 1) to give 1.91 g of the title compound.

TLC: Rf 0.82 (chloroform : methanol = 20:1)

[Process 2] Boc-(2R,3S)-AHPBA-Phe-NH-CH₂-CH(CH₃)₂

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 43 μ l of triethylamine under ice cooling. To the neutralized solution, 92 mg of Boc-(2R,3S)-AHPBA-OH, 138 mg of Bop reagent and 87 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and water was added to the resultant residue to give precipitates. The precipitates were washed with water and reprecipitated from DMF-ether to give 98 mg of the title compound.

TLC: Rf 0.86 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Val-(2R,3S)-AHPBA-Phe-NH-CH₂-CH(CH₃)₂

Deprotection of 30 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 8 μ l of triethylamine under ice cooling. To the neutralized solution, 26 mg of benzyloxycarbonyl-Val-OH.DCHA, 27 mg of Bop reagent and 8 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and water was added to the resultant residue to give precipitates. The precipitates were washed with water and reprecipitated from THF-ether to give 10 mg of the title compound.

TLC: Rf 0.36 (chloroform : methanol = 20:1)

FAB-MS: 631 (M+1)

Example 55: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu[Process 1] Boc-Pro-NH-tBu

In a DMF solution of 0.50 g of Boc-Pro-OH, 0.24 ml of tert-butylamine, 0.36 g of HOBt and 0.53 g of EDC hydrochloride were added under ice cooling and the mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2) to give 373 mg of the title compound.

TLC: Rf 0.41 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 52 μ l

of triethylamine under ice cooling. To the neutralized solution, 100 mg of Boc-(2S,3S)-AHPBA-OH, 164 mg of Bop reagent, 104 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 and crystallized from hexane to give 69 mg of the title compound.

TLC : Rf 0.38 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 30 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 9.3 μ l of triethylamine under ice cooling. To the neutralized solution, 52 mg of benzyloxycarbonyl-Asn-ONp, 21 mg of HOBt and 15 μ l of N-methylmorpholine were added and the resultant solution was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 49, except for the crystallization solvent (ether-hexane), to give 22 mg of the title compound.

TLC : Rf 0.29 (chloroform : methanol = 9:1)

FAB-MS: 596 (M+1)

Example 56: Benzyloxycarbonyl-Asn-(2R,3S)-AHPBA-Pro-NH-tBu

The title compound was synthesized by a similar method with that in Example 55.

Analytical HPLC: 18.36 min (For the condition, see: Example 35).

FAB-MS: 596 (M+1)

Example 57: 3-Phenylpropionyl-Asn-(2S,3S)-ACHBA-Pro-Ile-Val-NH₂

[Process 1] (2S,3S)-3-N-t-butoxycarbonylamino-4-cyclohexyl-2-hydroxybutanoic acid

In 2.5 ml of ethanol, 148 mg of Boc-(2S,3S)-AHPBA-OH was dissolved and 15 mg of 5% Rh/Al₂O₃ was added to the solution. The resultant mixture was stirred for 5 days at room temperature in the hydrogen atmosphere at 4.5 kg/cm². The reaction mixture was filtered to separate the catalyst using celite and the filtrate was evaporated under reduced pressure to give the title compound (hereinafter abbreviated as Boc-(2S,3S)-ACHBA-OH).

[Process 2] 3-Phenylpropionyl-Asn-(2S,3S)-ACHBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3) from Boc-(2S,3S)-ACHBA-OH prepared above.

Analytical HPLC: 19.46 min (For the condition, see: Example 35)

FAB-MS: 756 (M+1)

Example 58

3-Phenylpropionyl-Asn-(2R,3S)-ACHBA-Pro-Ile-Val-NH₂

[Process 1] Boc-(2R,3S)-ACHBA-OH

In 2.5 ml of ethanol, 148 mg of Boc-(2R,3S)-AHPBA-OH was dissolved and 15 mg of 5% Rh/Al₂O₃ was added to the solution. The resultant mixture was stirred for 5 days at room temperature in the hydrogen atmosphere at 4.5 kg/cm². The reaction mixture was filtered using celite to separate the catalyst and the filtrate was evaporated under reduced pressure to give the title compound.

[Process 2] 3-Phenylpropionyl-Asn-(2R,3S)-ACHBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3) from Boc-(2R,3S)-ACHBA-OH prepared above.

Analytical HPLC: 21.41 min (For the condition, see: Example 35)

FAB-MS: 756 (M+1)

Example 59: 3-Phenylpropionyl-His-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 15.22 min (For the condition, see: Example 35)
 FAB-MS: 773 (M+1)

Example 60: 3-Phenylpropionyl-Ser(Me)-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂[Process 1] Boc-Ser(Me)-OH.DCHA

In a DMF solution containing 2.00 g of Boc-Ser-OH, 0.86 g of sodium hydride (60% oily suspension) was added under ice cooling and the resultant mixture was stirred for 30 min. To the resultant solution, 0.72 ml of methyl iodide was added and the resultant solution was stirred for 3 hr. The reaction mixture was neutralized with citric acid and evaporated under reduced pressure. The obtained residue was redissolved in ethyl acetate, and the solution was washed with 5% aqueous citric acid solution and saturated aqueous sodium chloride solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure. The residue was subjected to a silica gel column chromatography (chloroform : methanol = 10:1) and crystallized as its DCHA salt from n-hexane to give 0.79 g of the title compound.
 TLC: R_f 0.45 (chloroform: methanol: acetic acid = 9:1:0.5)

[Process 2] 3-Phenylpropionyl-Ser(Me)-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 20.54 min (For the condition, see: Example 35)
 FAB-MS: 737 (M+1)

Example 61: 3-Phenylpropionyl-Smc(O)-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂[Process 1] N-(tert-Butoxycarbonyl)methanesulfinylalanine

In 10 ml of purified water, 1.0 g of S-methyl-L-cysteine was suspended and 1.54 ml of triethylamine was added under ice cooling. To this was added a solution of 1.94 g of Boc₂O in 10 ml of THF and the resultant reaction mixture was stirred for 14 hr. The reaction mixture was washed with ether and the aqueous layer was evaporated up to the half volume. The condensed solution was adjusted to pH 2-3 with citric acid and extracted with ethyl acetate, washed with saturated aqueous sodium chloride solution. To the organic solution, was added an aqueous solution of 1.36 g of sodium perborate tetrahydrate, and the reaction mixture was stirred overnight. The organic layer was washed with saturated sodium chloride aqueous solution and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and ether was added to the residue to crystallize 1.33 g of the title compound [Boc-Smc(O)-OH].
 TLC: R_f 0.51 (n-BuOH: acetic acid: pyridine: H₂O = 4:1:1:2)

[Process 2] 3-Phenylpropionyl-Smc(O)-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 17.86 and 18.61 min (For the condition, see: Example 35)
 FAB-MS: 769 (M+1)

Example 62: 3-Phenylpropionyl-Msa-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂[Process 1] N-(tert-Butoxycarbonyl)methanesulfonylalanine

In 2 ml of chloroform, 300 mg of Boc-Smc(O)-OH was dissolved, 206 mg of m-chloroperbenzoic acid was added and the resultant mixture was stirred for 14 hr. The reaction mixture was filtered, and the filtrate was evaporated and crystallized by the addition of a mixture of ether and n-hexane to give 267 mg of the title compound.
 TLC: R_f 0.60 (n-BuOH: acetic acid: pyridine: H₂O = 4:1:1:2)

[Process 2] 3-Phenylpropionyl-Msa-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 19.21 min (For the condition, see: Example 35)

5 FAB-MS: 785 (M+1)

Example 63: Fmoc-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 22.57 min (For the condition, see: Example 35)

10 FAB-MS: 840 (M+1)

Example 64: 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 20.06 min (For the condition, see: Example 35)

15 FAB-MS: 802 (M+1)

Example 65: Furancarboxyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 12.92 min (For the condition, see: Example 35)

20 FAB-MS: 712 (M+1)

Example 66: Pyrazinecarbonyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 11.54 min (For the condition, see: Example 35)

25 FAB-MS: 724 (M+1)

Example 67: Thiophenecarbonyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 14.18 min (For the condition, see: Example 35)

30 FAB-MS: 728 (M+1)

Example 68: L-Indoline-2-carboxyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
Analytical HPLC: 14.41 min (For the condition, see: Example 35)

35 FAB-MS: 763 (M+1)

Example 69: H-(D)-Tic-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂Example 70: H-(L)-Tic-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

D- and L-form of 1,2,3,4-Tetrahydroisoquinoline-3-carboxyl-Asn-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂ were obtained by a solid phase method similar to Example 16 (Process 3).

Analytical HPLC (D): 11.17 min (For the condition, see: Example 35)

50 Analytical HPLC (L): 12.52 min (For the condition, see: Example 35)

FAB-MS: 777 (M+1)

Example 71: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA(OMe)-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3). AHPBA(OMe) means 3-amino-2-hydroxy-4-(p-methoxyphenyl)butanoic acid residue.

Analytical HPLC: 18.01 min (For the condition, see: Example 35)

55 FAB-MS: 780 (M+1)

Example 72: 3-Phenylpropionyl-Met(O)₂-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 18.68 min (For the condition, see: Example 35)
 FAB-MS: 799 (M+1)

Example 73: 3-Phenylpropionyl-Ser-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 18.17 min (For the condition, see: Example 35)
 FAB-MS: 723 (M+1)

Example 74: 3-Phenylpropionyl-Leu-(2S,3S)-AHPBA-Pro-Ile-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 25.03 min (For the condition, see: Example 35)
 FAB-MS: 749 (M+1)

Example 75: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Gln-Ile-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 21.78 min (For the condition, see: Example 35)
 FAB-MS: 779 (M+1)

Example 76: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Val-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 14.78 min (For the condition, see: Example 35)
 FAB-MS: 637 (M+1)

Example 77: 3-Phenylpropionyl-Asn-(2S,3S)-AHPBA-Pro-Ile-NH₂

The title compound was obtained by a solid phase method similar to Example 16 (Process 3).
 Analytical HPLC: 16.13 min (For the condition, see: Example 35)
 FAB-MS: 651 (M+1)

Example 78: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-(L)-Pip-NH-tBu

Example 79: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-(D)-Pip-NH-tBu

[Process 1] Boc-(DL)-Pip-NH-tBu

In a DMF solution containing 0.20 g of N-(tert-butoxy-carbonyl)-(DL)-pipecolic acid, 92 μ l of tert-butylamine, 134 mg of HOBt and 200 mg of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 30 (Process 3) to give 108 mg of the title compound
 TLC: Rf 0.39 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-(DL)-Pip-NH-tBu

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 49 μ l of triethylamine under ice cooling. To the neutralized solution, 104 mg of Boc-(2S,3S)-AHPBA-OH, 156 mg of Bop reagent, 98 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 to give 109 mg of the title compound.
 TLC : Rf 0.65 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-(L)-Pip-NH-tBu and Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-(D)-Pip-NH-tBu

Deprotection of 100 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 30 μ l of triethylamine under ice cooling. To the neutralized solution, 169 mg of benzyloxycarbonyl-Asn-ONp, 66 mg of HOBt and 48 μ l of N-methylmorpholine were added and the resultant solution was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 55 (Process 3) to give 58 mg of benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-(DL)-Pip-NH-tBu.

TLC: Rf 0.55 (chloroform : methanol = 9:1)

The obtained mixture was dissolved in methanol, fractionated by a reversed-phase HPLC and lyophilized to give the title compounds.

FAB-MS: 610 (M+1)

Example 80: Boc-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 85 mg of the compound obtained by Example 55 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 27 μ l of triethylamine under ice cooling. To the neutralized solution, 134 mg of Boc-Asn-ONp, 58 mg of HOBt, 42 μ l of N-methylmorpholine were added and the resultant solution was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 55 (Process 3) to give 51 mg of the title compound.

TLC: Rf 0.33 (chloroform : methanol = 9:1)

Example 81: 1-Naphthylmethyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

[Process 1] 1-Naphthylmethyl 4-nitrophenyl carbonate

In 5 ml of pyridine containing 1.0 g of 1-naphthyl-methanol, 1.27 g of 4-nitrophenyl chloroformate was added under ice cooling and the resultant mixture was stirred for 3 hr. Purified water and ethyl acetate, each 20 ml, were added to the reaction mixture and the ethyl acetate layer was separated and washed with purified water. The ethyl acetate layer was dried over anhydrous sodium sulfate, evaporated under reduced pressure and crystallized by the addition of ethanol to give 1.08 g of the title compound.

TLC: Rf 0.81 (chloroform)

[Process 2] 1-Naphthylmethyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 30 mg of the compound obtained by Example 55 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 8 μ l of triethylamine under ice cooling. To the neutralized solution, 35 mg of 1-naphthylmethyl 4-nitrophenyl carbonate 12 μ l of N-methylmorpholine were added and the resultant solution was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 49 to give 5 mg of the title compound.

TLC: Rf 0.40 (chloroform : methanol = 9:1)

FAB-MS: 646 (M+1)

Example 82: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Thz-NH-tBu

[Process 1] Boc-Thz-NH-tBu

In a DMF solution containing 0.10 g of N-(t-butoxy-carbonyl)-1,3-thiazolidine-4-carboxylic acid, 45 μ l of tert-butylamine, 66 mg of HOBt and 98 mg of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 33 (Process 3) to give 90 mg of the title compound.

TLC: Rf 0.43 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 50 mg of the compound obtained by the process 1 in the presence of 25 μ l of anisole and 14 μ l of 1,2-ethanedithiol was performed similarly to that in Example 28 (Process 3), and the obtained product

was dissolved in 5 ml of DMF and neutralized with 24 μ l of triethylamine under ice cooling. To the neutralized solution, 51 mg of Boc-(2S,3S)-AHPBA-OH, 77 mg of Bop reagent, 48 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 28 (Process 3) and crystallized from hexane to give 51 mg of the title compound.

TLC: Rf 0.64 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 51 mg of the compound obtained by the process 2 in the presence of 25 μ l of anisole and 10 μ l of ethanedithiol was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 15 μ l of triethylamine under ice cooling. To the neutralized solution, 85 mg of benzyloxycarbonyl-Asn-ONp, 34 mg of HOBt and 24 μ l of N-methylmorpholine were added and the resultant solution was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 49 to give 20 mg of benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Thz-NH-tBu. In methanol, seven mg of the obtained crystals were dissolved, fractionated by a reversed-phase HPLC and lyophilized to give four mg of the title compound.

Analytical HPLC: 21.37 min (For the condition, see: Example 35).

FAB-MS: 614 (M+1)

¹H NMR (CDCl₃, 500 MHz): Fig. 1

Example 83: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-CH₂-C(CH₃)₃

[Process 1] Boc-Pro-NH-CH₂-C(CH₃)₃

In a DMF solution containing 1.00 g of Boc-Pro-OH, 0.58 ml of neopentylamine, 0.71 g of HOBt and 1.06 g of EDC hydrochloride were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 30 (Process 3) to give 605 mg of the title compound.

TLC: Rf 0.56 (chloroform : methanol = 20:1)

[Process 2] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-CH₂-C(CH₃)₃

The title compound was obtained according to the method of Example 55 from the protected amino acid obtained in the above process 1.

Analytical HPLC: 21.24 min (For the condition, see: Example 35)

FAB-MS: 610 (M+1)

Example 84: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-C₆H₁₁

[Process 1] Boc-Pro-NH-C₆H₁₁

In a DMF solution containing 1.00 g of Boc-Pro-OH, 0.53 ml of cyclohexylamine, 0.63 g of HOBt and 1.07 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 30 (Process 3) to give 853 mg of the title compound.

TLC: Rf 0.77 (chloroform : methanol = 20:1)

[Process 2] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-C₆H₁₁

The title compound was obtained according to the method of Example 55 from the protected amino acid obtained in the above process 1.

TLC: Rf 0.44 (chloroform : methanol = 9:1)

FAB-MS: 622 (M+1)

Example 85: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-CH(CH₃)₂

[Process 1] Boc-Pro-NH-CH(CH₃)₂

In a DMF solution containing 1.00 g of Boc-Pro-OH, 0.40 ml of isopropylamine, 0.71 g of HOBt and 1.06 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred for 14 hr. The reac-

tion mixture was treated similarly to that in Example 28 (Process 2) to give 654 mg of the title compound.
TLC: Rf 0.41 (chloroform : methanol = 20:1)

[Process 2] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-CH(CH₃)₂

The title compound was obtained according to the method of Example 55 from the protected amino acid obtained in the above process 1.

Analytical HPLC: 17.57 min (For the condition, see: Example 35)

FAB-MS: 582 (M+1)

Example 86: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-O-tBu

[Process 1] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-O-benzyl

Deprotection of 190 mg of Boc-(2S,3S)-AHPBA-O-benzyl obtained by Example 16 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 69 μ l of triethylamine under ice cooling. To the neutralized solution, 286 mg of benzyloxycarbonyl-Asn-ONp, 113 mg of HOBt and 81 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was mixed with purified water and the formed precipitates were collected and washed thoroughly with purified water. The precipitates were recovered and reprecipitated from DMF-ether to give 240 mg of the title compound.
TLC: Rf 0.60 (chloroform : methanol:water = 8:3:1, lower layer)

[Process 2] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-OH

In 3 ml of DMF, 230 mg of the peptide obtained by the process 1 was dissolved and stirred with 0.52 ml of 1N-NaOH under ice cooling for 2 hr. The reaction mixture was neutralized with citric acid and evaporated under reduced pressure. To the resultant residue, 5% citric acid aqueous solution was added to cause precipitation and the precipitates were reprecipitated from DMF and ether to give 140 mg of the title compound.
TLC: Rf 0.59 (n-BuOH:acetic acid:pyridine:water = 4:1:1:2)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-O-tBu

In 2 ml of DMF, 19 mg of H-Pro-O-tBu hydrochloride was dissolved and neutralized with 13 μ l of triethylamine under ice cooling. To the neutralized solution, 20 mg of benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-OH, 20 mg of Bop reagent and 26 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 49, except for the crystallization solvent (hexane), to give 22 mg of the title compound.

TLC: Rf 0.48 (chloroform : methanol = 9:1)

FAB-MS: 597 (M+1)

¹H NMR (CDCl₃, 500 MHz): Fig. 2

Example 87: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tAmyl

[Process 1] Boc-Pro-NH-tAmyl

In a DMF solution containing 0.50 g of Boc-Pro-OH, 0.27 ml of tert-amylamine, 0.36 g of HOBt and 0.53 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture treated similarly to that in Example 28 (Process 2) to give 448 mg of the title compound.

TLC: Rf 0.56 (chloroform : methanol = 20:1)

[Process 2] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tAmyl

Deprotection of 20 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 10 μ l of triethylamine under ice cooling. To the neutralized solution, 31 mg of benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-OH, 31 mg of Bop reagent, 20 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 55 (Process 3) to give 33 mg of the title com-

pound.

Analytical HPLC: 21.98 min (For the condition, see: Example 35.)

FAB-MS: 610 (M+1)

5 Example 88: Benzylloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-cyclopropyl

[Process 1] Boc-Pro-NH-cyclopropyl

10 In a DMF solution containing 0.50 g of Boc-Pro-OH, 0.16 ml of cyclopropylamine, 0.36 g of HOBt and 0.53 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 30 (Process 3) to give 245 mg of the title compound.
TLC: Rf 0.47 (chloroform : methanol = 20:1)

15 [Process 2] Benzylloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-cyclopropyl

The title compound was obtained according to the method of Example 87 from the protected amino acid obtained in the above process 1.

TLC: Rf 0.60 (chloroform : methanol:water = 8:3:1, lower layer)

FAB-MS: 580 (M+1)

20 Example 89: Benzylloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-CH(C₂H₅)₂

[Process 1] Boc-Pro-NH-CH(C₂H₅)₂

25 In a DMF solution containing 0.50 g of Boc-Pro-OH, 0.27 ml of 1-ethylpropylamine, 0.36 g of HOBt and 0.53 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 30 (Process 3) to give 324 mg of the title compound.
TLC: Rf 0.57 (chloroform : methanol = 20:1)

30 [Process 2] Benzylloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-CH(C₂H₅)₂

The title compound was obtained according to the method of Example 87 from the protected amino acid obtained in the above process 1.

TLC: Rf 0.48 (chloroform : methanol = 9:1)

35 FAB-MS: 610 (M+1)

Example 90: 1-Naphthylmethyloxycarbonyl-Msa-(2S,3S)-AHPBA-Pro-NH-tBu

[Process 1] Boc-Msa-(2S,3S)-AHPBA-Pro-NH-tBu

40 Deprotection of 30 mg of the compound obtained by Example 55 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 10 μ l of triethylamine under ice cooling. To the neutralized solution, 18 mg of Boc-Msa-OH, 30 mg of Bop reagent and 19 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture
45 was treated similarly to that in Example 86 (Process 3) to give 27 mg of the title compound.
TLC: Rf 0.52 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthylmethyloxycarbonyl-Msa-(2S,3S)-AHPBA-Pro-NH-tBu

50 The title compound was obtained according to the method of Example 81 from the protected peptide obtained the above process 1.

TLC: Rf 0.50 (chloroform : methanol = 9:1)

FAB-MS: 681 (M+1)

55 Example 91: 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 22 mg of the compound obtained by Example 80 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 5.4 μ l of

triethylamine under ice cooling. To the neutralized solution, 8 mg of 1-naphthoxyacetic acid, 17 mg of Bop reagent and 11 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 50 (Process 2) to give 23 mg of the crude title compound. In methanol, 8 mg of the obtained crystals were dissolved, fractionated by a reversed-phase HPLC and lyophilized to give 4 mg of the title compound.

Analytical HPLC: 23.14 min (For the condition, see: Example 35.)

FAB-MS: 646 (M+1)

Example 92: Fmoc-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 30 mg of the compound obtained by Example 55 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 9.3 μ l of triethylamine under ice cooling. To the neutralized solution, 70 mg of Fmoc-Asn-O-pentafluorophenyl, 21 mg of HOBt and 15 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 50 (Process 2) to give 85 mg of the crude product. In methanol, 12 mg of the crude product was dissolved, fractionated by a reversed-phase HPLC and lyophilized to give 4.8 mg of the title compound.

TLC: Rf 0.36 (chloroform : methanol = 9:1)

FAB-MS: 684 (M+1)

Example 93: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-Aib-NH₂

[Process 1] Boc-Aib-NH₂

In a DMF solution containing 1.00 g of 2-N-(tert-butoxycarbonyl)aminoisobutyric acid, 0.75 ml of triethylamine and 0.70 ml of isobutyl chloroformate were added at -10 to -20 °C and the resultant mixture was stirred for 10 min. To the solution, 1.03 ml of concentrated ammonia water (28%) was added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and water was added to the residue. The formed precipitates were thoroughly washed with purified water and re-precipitated from THF - ether to give 200 mg of the title compound.

TLC: Rf 0.63 (chloroform : methanol:water = 8:3:1, lower layer)

[Process 2] Boc-Pro-Aib-NH₂

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 68 μ l of triethylamine under ice cooling. To the neutralized solution, 107 mg of Boc-Pro-OH, 237 mg of Bop reagent and 137 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 86 (Process 3) to give 35 mg of the title compound.

TLC: Rf 0.48 (chloroform : methanol = 9:1)

[Process 3] Boc-(2S,3S)-AHPBA-Pro-Aib-NH₂

Deprotection of 35 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 17 μ l of triethylamine under ice cooling. To the neutralized solution, 35 mg of Boc-(2S,3S)-AHPBA-OH, 53 mg of Bop reagent, and 33 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46, except for the chromatography solvent (chloroform : methanol = 10:1), to give 36 mg of the title compound.

TLC: Rf 0.28 (chloroform : methanol = 9:1)

[Process 4] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-Aib-NH₂

Deprotection of 35 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 10 μ l of triethylamine under ice cooling. To the neutralized solution, 57 mg of benzyloxycarbonyl-Asn-ONp, 23 mg of HOBt and 16 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 55 (Process 3) to give the crude product.

dissolved in methanol, fractionated by a reversed-phase HPLC and lyophilized to give 5.3 mg of the title compound.

TLC: Rf 0.63 (chloroform : methanol:water = 8:3:1, lower layer)

FAB-MS: 625 (M+1)

Example 94: Bis(4-chlorophenyl)methoxyacetyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 25 mg of the compound obtained by Example 80 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 6.0 μ l of triethylamine under ice cooling. To the neutralized solution, 26 mg of bis(4-chlorophenyl)methoxyacetic acid, 24 mg of Bop reagent, and 6 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 50 (Process 2) and the formed precipitates were dissolved in methanol. The methanol solution was fractionated by a reversed-phase HPLC and lyophilized to give the title compound.

Analytical HPLC: 29.97 min (For the condition, see: Example 35).

FAB-MS: 755 (M+1)

Example 95: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Hyp(Bzl)-NH-tBu

[Process 1] Boc-Hyp(Bzl)-NH-tBu

In a DMF solution containing 100 mg of Boc-Hyp(Bzl)-OH, 33 μ l of t-butylamine, 48 mg of HOBt and 71 mg of EDC hydrochloride were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 33 (Process 3) to give 88 mg of the title compound.

[Process 2] Boc-(2S,3S)-AHPBA-Hyp(Bzl)-NH-tBu

Deprotection of 76 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 28 μ l of triethylamine under ice cooling. To the neutralized solution, 60 mg of Boc-(2S,3S)-AHPBA-OH, 89 mg of Bop reagent and 56 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 28 (Process 3) to give 92 mg of the title compound.

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Hyp(Bzl)-NH-tBu

Deprotection of 30 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 4 ml of DMF and neutralized with 6.4 μ l of triethylamine under ice cooling. To the neutralized solution, 36 mg of benzyloxycarbonyl-Asn-ONp, 14 mg of HOBt and 10 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 49 to give 23 mg of the title compound.

TLC: Rf 0.41 (chloroform : methanol = 9:1)

Analytical HPLC: 26.65 min (For the condition, see: Example 35.)

FAB-MS: 702 (M+1)

Example 96: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Inc-NH-tBu

[Process 1] Boc-Inc-NH-tBu

In a DMF solution containing 500 mg of Boc-Inc-OH, 200 μ l of t-butylamine, 291 mg of HOBt and 435 mg of EDC hydrochloride were added and the resultant mixture was stirred for 14 hr under ice cooling. The reaction mixture was treated similarly to that in Example 33 (Process 3) to give the title compound.

[Process 2] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Inc-NH-tBu

Deprotection of 20 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3) in the presence of 10 μ l of anisole and 26 μ l of 1,2-ethanedithiol, and the obtained product was dissolved in 3 ml of DMF and neutralized with 7 μ l of triethylamine under ice cooling. To the neutralized solution, 22 mg of Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-OH, 22 mg of Bop reagent and 11 μ l of

triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 50 (Process 2) subjected to a reversed-phase HPLC to give 355 mg of the title compound.

Analytical HPLC: 22.88 min (For the condition, see: Example 35.)

FAB-MS: 644 (M+1)

Example 97: Boc-Sma-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 30 mg of the compound obtained by Example 55 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of dichloromethane. To the dichloromethane solution, 30 mg of Boc-Sma-OH.DCHA and 435 mg of EDC hydrochloride were added under ice cooling and the mixture was stirred overnight. The reaction mixture was treated similarly to that in Example 50 (Process 2) to give 7 mg of the title compound.

TLC: Rf 0.61 (chloroform : methanol:H₂O = 8:3:1)

Example 98: 1-Naphthoxyacetyl-Sma-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 7 mg of the compound obtained by Example 97 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 2 ml of DMF and neutralized with 1.6 μ l of triethylamine under ice cooling. To the neutralized solution, 2.4 mg of 1-naphthoxyacetic acid, 5.2 mg of Bop reagent and 3.2 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 51 (Process 2), and the crude product was dissolved in methanol and subjected to a reversed-phase HPLC (water-acetonitrile system) and fractionated, purified and lyophilized to give 0.83 mg of the title compound.

Analytical HPLC: 25.08 min (For the condition, see: Example 35.)

FAB-MS: 682 (M+1)

Example 99: Benzylloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-C(CH₃)₂-CH₂OH

[Process 1] Boc-Pro-NH-C(CH₃)₂-CH₂OH

In a DMF solution containing 0.20 g of Boc-Pro-OH, 0.09 ml of 2-amino-2-methyl-1-propanol, 0.14 g of HOBt and 0.21 g of EDC hydrochloride were added and the resultant mixture was stirred for 14 hrs. The reaction mixture was treated similarly to that in Example 46 to give 80 mg of the title compound.

TLC: Rf 0.32 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-Pro-NH-C(CH₃)₂-CH₂OH

Deprotection of 50 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 24 μ l of triethylamine under ice cooling. To the neutralized solution, 52 mg of Boc-(2S,3S)-AHPBA-OH, 77 mg of Bop reagent and 48 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 55 (Process 2) to give 54 mg of the title compound.

TLC: Rf 0.53 (chloroform : methanol = 9:1)

[Process 3] Benzylloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-1H-C(CH₃)₂-CH₂OH

Deprotection of 30 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 9 μ l of triethylamine under ice cooling. To the neutralized solution, 50 mg of benzylloxycarbonyl-Asn-ONp, 20 mg of HOBt and 14 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 49 to give 6.6 mg of the title compound.

Analytical HPLC: 16.37 min (For the condition, see: Example 35.)

FAB-MS: 612 (M+1)

Example 100: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] Boc-Msa-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 65 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 20 μ l of triethylamine under ice cooling. To the neutralized solution, 38 mg of Boc-methanesulfonylalanine, 62 mg of Bop reagent and 40 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 55 (Process 2) to give 34 mg of the title compound.

TLC: Rf 0.53 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 34 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 8.0 μ l of triethylamine under ice cooling. To the neutralized solution, 12 mg of 1-naphthoxyacetic acid, 25 mg of Bop reagent and 16 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 and ether was added to give 26 mg of the crude above mentioned compound. In methanol, 5 mg of the crude solid was dissolved, fractionated by a reversed-phase HPLC and lyophilized to give 1.4 mg of the title compound.

Analytical HPLC: 27.08 min (For the condition, see: Example 35.)

FAB-MS: 699 (M+1)

¹H NMR (DMSO-d₆, 500 MHz): Fig. 3

Example 101: 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] Boc-Asn-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 28 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 8 μ l of triethylamine under ice cooling. To the neutralized solution, 40 mg of Boc-Asn-ONp, 8 mg of HOBt and 12 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 28 mg of the title compound.

[Process 2] 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 28 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 6.5 of triethylamine under ice cooling. To the neutralized solution, 9.5 mg of 1-naphthoxyacetic acid, 21 mg of Bop reagent and 13 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 and ether was added to give the crude above mentioned compound. The crude solid was dissolved in methanol, subjected to a reversed-phase HPLC (water-acetonitrile system) and fractionated, purified and lyophilized to give 5.8 mg of the title compound.

Analytical HPLC: 24.38 min (For the condition, see: Example 35.)

FAB-MS: 664 (M+1)

Example 102-103: Benzoyloxycarbonyl-Asn-(2S,3S)-AHPBA-(DL)Tic-NH-tBu[Process 1] Boc-(DL)-Tic-NH-tBu

In a DMF solution containing 200 mg of N-(tert-butoxycarbonyl)-(DL)-1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid, 76 μ l of tert-butylamine, 110 mg of HOBt and 165 mg of EDC hydrochloride were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2) to give 150 mg of the title compound.

TLC: Rf 0.80 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-(DL)-Tic-NH-tBu

Deprotection of 60 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 25 μ l of triethylamine under ice cooling. To the neutralized solution, 53 mg of Boc-(2S,3S)-AHPBA-OH, 80 mg of Bop reagent and 50 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 28 (Process 3) to give 81 mg of the title compound.
TLC: Rf 0.59 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-(DL)-Tic-NH-tBu

Deprotection of 81 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 8 ml of DMF and neutralized with 22 μ l of triethylamine under ice cooling. To the neutralized solution, 124 mg of benzyloxycarbonyl-Asn-ONp, 24 mg of HOBT and 35 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 46 and crystallized by the addition of ether to give 44 mg of the crude title compound. In methanol, 10 mg of the crude solid was dissolved, fractionated by a reversed-phase HPLC and lyophilized to give the title compound.

Analytical HPLC: 24.44 and 25.16 min (For the condition, see: Example 35.)

FAB-MS: 658 (M+1)

Example 104: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu[Process 1] Boc-Dtc-NH-tBu

In a methylene chloride solution containing 3.0 g of Boc-Dtc-OH, 1.45 ml of triethylamine, 2.89 g of 2-chloro-1,3-dimethylimidazolium hexafluorophosphate and 3.28 ml of tert-butylamine were added, and the resultant mixture was stirred for 14 hr. The resultant solution was treated similarly to that in Example 33 (Process 3) to give 2.49 g of the title compound as a mixture of cisoide and transoid.

TLC: Rf 0.54, 0.24 (chloroform : methanol = 40:1)

[Process 2] Boc-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 2.49 g of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 60 ml of methylene chloride and neutralized with 1.10 ml of triethylamine under ice cooling. To the neutralized solution, 3.75 g of Boc-(2S,3S)-AHPBA-OH-DCHA salt, 3.48 g of Bop reagent and 1.10 ml of triethylamine were added and the resultant mixture was stirred overnight. Further, 1.74 g of Bop reagent and 1.10 ml of triethylamine were added and the resultant mixture was stirred overnight. The reaction mixture was treated similarly to that in Example 33 (Process 3) to give 2.81 g of the title compound.

TLC: Rf 0.66, 0.73 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 53 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 15 μ l of triethylamine under ice cooling. To the neutralized solution, 83 mg of benzyloxycarbonyl-Asn-ONp, 17 mg of HOBT and 24 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 46 and crystallized by the addition of ether to give 27 mg of the crude title compound. The crude solid was dissolved in methanol, fractionated by a reversed-phase HPLC and lyophilized to give 10.6 mg of the title compound.

Analytical HPLC: 23.80 min (For the condition, see: Example 35.)

FAB-MS: 642 (M+1)

Example 105: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Dtc-NH-tBu[Process 1] Boc-Msa-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 69 mg of the compound obtained by Example 104 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 20 μ l of triethylamine under ice cooling. To the neutralized solution, 38 mg of Boc-methanesulfonylalanine, 62 mg of Bop reagent and 40 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 55 (Process 2) to give 55 mg of the title compound.

TLC: Rf 0.62 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 55 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 12 μ l of triethylamine under ice cooling. To the neutralized solution, 18 mg of 1-naphthoxyacetic acid, 38 mg of Bop reagent, and 24 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46, except for the chromatography solvent (chloroform : methanol = 15:1), to give 37 mg of the crude title compound. In methanol, 14 mg of the crude solid was dissolved, fractionated by a reversed-phase HPLC and lyophilized to give 6.5 mg of the title compound.

Analytical HPLC: 29.40 min (For the condition, see: Example 35.)

FAB-MS: 727 (M+1)

Example 106: 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu[Process 1] Boc-Asn-(2S, 3S)-AHPBA-Dtc-NH-tBu

Deprotection of 2.81 g of the compound obtained by Example 104 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 50 ml of DMF and neutralized with 0.79 ml of triethylamine under ice cooling. To the neutralized solution, 3.02 g of Boc-Asn-ONp, 1.31 g of HOBt and 0.94 ml of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was evaporated under reduced pressure and the residue was mixed with 5% sodium hydrogencarbonate aqueous solution to give precipitates. The precipitates were filtered, washed and dried. The precipitates were subjected to a silica gel column chromatography (chloroform : methanol = 10:1) to give 1.50 g of the title compound.

TLC: Rf 0.30 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 44 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 10 μ l of triethylamine under ice cooling. To the neutralized solution, 15 mg of 1-naphthoxyacetic acid, 32 mg of Bop reagent and 20 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46, except for the chromatography solvent (chloroform : methanol = 15:1), to give the above mentioned compound. The solid was dissolved in methanol, fractionated by a reversed-phase HPLC and lyophilized to give 10.5 mg of the title compound.

Analytical HPLC: 26.68 min (For the condition, see: Example 35.)

FAB-MS: 692 (M+1)

^1H NMR (DMSO- d_6 , 500 MHz): Fig. 4 —

Example 107: 1-Naphthylmethyloxycarbonyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 40 mg of the compound obtained by Example 106 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 9 μ l of triethylamine under ice cooling. To the neutralized solution, 32 mg of 1-naphthylmethyl 4-nitrophenyl carbonate, 15 mg of HOBt and 14 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was mixed with 5% aqueous sodium hydrogencarbonate solution to give precipitates. The precipitates were filtered,

washed with water and dried. The dried precipitates were dissolved in methanol, fractionated by a reversed-phase HPLC and lyophilized to give 6.4 mg of the title compound.

Analytical HPLC: 26.93 min (For the condition, see: Example 35.)

FAB-MS: 692 (M+1)

Example 108: (E)-Phenyl-CH=CH-CH₂CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 40 mg of the compound obtained by Example 106 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 9 μ l of triethylamine under ice cooling. To the neutralized solution, 11 mg of transstyrylacetic acid, 29 mg of Bop reagent and 18 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 107 to give 5.6 mg of the title compound.

Analytical HPLC: 24.49 min (For the condition, see: Example 35.)

FAB-MS: 652 (M+1)

Example 109: o-Chlorophenoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 40 mg of the compound obtained by Example 106 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 9 μ l of triethylamine under ice cooling. To the neutralized solution, 11 mg of o-chlorophenoxyacetic acid, 29 mg of Bop reagent and 18 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 107 to give 10.5 mg of the title compound.

Analytical HPLC: 24.49 min (For the condition, see: Example 35.)

FAB-MS: 676 (M+1)

Example 110: o-Phenylphenoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

[Process 1] o-Phenylphenoxyacetic acid DCHA salt

In 10 ml of acetonitrile, 1.0 g of o-phenylphenol and 1.29 ml of ethyl bromoacetate were added in the presence of 1.76 ml of 1,8-diazabicyclo[5.4.0]-7-undecene (DBU) and the resultant mixture was refluxed for 8 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2) to give 1.46 g of ethyl o-phenylphenoxyacetate. The ester was dissolved in 30 ml of ethanol, mixed with 10.8 ml of 1N-NaOH aqueous solution and stirred for 12 hr. The reaction mixture was evaporated under reduced pressure, acidified by the addition of 1N-HCl and extracted with ethyl acetate. The extract was washed with saturated sodium chloride aqueous solution and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and o-phenylphenoxyacetic acid was crystallized as DCHA salt from ether with the yield of 1.59 g. TLC: Rf 0.40 (chloroform : methanol:acetic acid = 9:1:0.5)

[Process 2] o-Phenylphenoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 40 mg of the compound obtained by Example 106 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 9 μ l of triethylamine under ice cooling. To the neutralized solution, 34 mg of o-phenylphenoxyacetic acid DCHA salt, 29 mg of Bop reagent and 18 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 107 to give 9.4 mg of the title compound.

Analytical HPLC: 28.38 min (For the condition, see: Example 35.)

FAB-MS: 718 (M+1)

Example 111: m-Phenylphenoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

The compound shown above was obtained by the similar method to that of Example 110.

Analytical HPLC: 28.40 min (For the condition, see: Example 35.)

FAB-MS: 718 (M+1)

Example 112: p-Phenylphenoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

The compound shown above was obtained by the similar method to that of Example 110.

Analytical HPLC: 28.16 min (For the condition, see: Example 35.)

FAB-MS: 718 (M+1)

Example 113: m-Chlorophenoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

The compound shown above was obtained by the similar method to that of Example 110.

Analytical HPLC: 25.21 min (For the condition, see: Example 35.)

FAB-MS: 676 (M+1)

Example 114: 5,6,7,8-Tetrahydro-1-naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

The compound shown above was obtained by the similar method to that of Example 110.

Analytical HPLC: 28.48 min (For the condition, see: Example 35.)

FAB-MS: 696 (M+1)

Example 115: 5-Isoquinolyloxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu[Process 1] 5-Isoquinolyloxyacetic acid

In 10 ml of acetonitrile, 1.0 g of 5-hydroxyisoquinoline and 1.52 ml of ethyl bromoacetate were added in the presence of 2.07 ml of DBU and the resultant mixture was refluxed for 8 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in 1N-HCl, washed with ethyl acetate. The aqueous layer was made alkaline with sodium hydrogencarbonate and extracted with ethyl acetate. The extract was washed with saturated sodium chloride aqueous solution and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and subjected to a silica gel column chromatography (chloroform) to give 1.46 g of ethyl 5-isoquinolyl-oxyacetate: The ester was dissolved in 30 ml of ethanol, mixed with 6.5 ml of 1N-NaOH aqueous solution and stirred for 12 hr. The reaction mixture was evaporated under reduced pressure, neutralized by the addition of 1N-HCl and the precipitated crystals were filtered, washed with water and dried to give 0.68 g of the title compound.

[Process 2] 5-Isoquinolyloxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 40 mg of the compound obtained by Example 106 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 9 μ l of triethylamine under ice cooling. To the neutralized solution, 14 mg of 5-isoquinolyloxyacetic acid, 29 mg of Bop reagent and 18 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 107 to give 3.3 mg of the title compound.

Analytical HPLC: 14.84 min (For the condition, see: Example 35.)

FAB-MS: 693 (M+1)

Example 116: m-Phenylaminophenoxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

The compound shown above was obtained by a similar method to that of Example 115.

Analytical HPLC: 26.97 min (For the condition, see: Example 35.)

FAB-MS: 733 (M+1)

Example 117: 8-Quinolyloxyacetyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

The compound shown above was obtained by a similar method to that of Example 115.

Analytical HPLC: 15.49 min (For the condition, see: Example 35.)

FAB-MS: 693 (M+1)

Example 118: 2-Quinolinecarbonyl-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 40 mg of the compound obtained by Example 106 (Process 1) was performed similarly to

that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 9 μ l of triethylamine under ice cooling. To the neutralized solution, 12 mg of 2-quinolinecarboxylic acid, 29 mg of Bop reagent and 18 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was re-dissolved in ethyl acetate.

5 The extract was washed with 5% sodium hydrogencarbonate aqueous solution, then with saturated sodium chloride aqueous solution and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure, dissolved in methanol, fractionated by a reversed-phase HPLC and lyophilized to give 7.2 mg of the title compound.

Analytical HPLC: 24.25 min (For the condition, see: Example 35.)

10 FAB-MS: 648 (M+1)

Example 119: 1-Naphthoxyacetyl-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu

[Process 1] Boc-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu

15 Deprotection of 390 mg of the compound obtained by Example 104 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 10 ml of DMF and neutralized with 110 μ l of triethylamine under ice cooling. To the neutralized solution, 186 mg of Boc-methylthioalanine, 349 mg of Bop reagent and 220 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr.

20 The reaction mixture was treated similarly to that in Example 28 (Process 3) to give 166 mg of the title compound.

TLC: Rf 0.63 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu

25 Deprotection of 50 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3) in the presence of 25 μ l of anisole, and the obtained product was dissolved in 5 ml of DMF and neutralized with 12 μ l of triethylamine under ice cooling. To the neutralized solution, 17 mg of 1-naphthoxyacetic acid, 36 mg of Bop reagent and 23 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 61 mg of the crude above mentioned compound. In methanol, 40 mg of the crude solid was dissolved, fractionated by a reversed-phase HPLC and lyophilized to give 17.7 mg of the title compound.

30 Analytical HPLC: 27.88 min (The condition was as follows) Column: YMC AM-302 (4.6 x 150 mm)

Solvent A: 0.1% trifluoroacetic acid aqueous solution

35 Solvent B: acetonitrile

Gradient: 30% B for 2 min, then B was increased in 2% /min

Flow rate: 0.7 ml/min

FAB-MS: 695 (M+1)

40 Example 120: 8-Quinolylxyacetyl-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu

The compound shown above was obtained by a similar method to that of Example 115.

Analytical HPLC: 18.89 min (For the condition, see: Example 35.)

45 FAB-MS: 696 (M+1)

Example 121: 1-Naphthoxyacetyl Mta⁺(Me)-(2S,3S)-AHPBA-Dtc-NH-tBu.AcO⁻

50 In methanol solution containing 10 mg of compound obtained by Example 119, 200 μ l of methyl iodide was added and the resultant mixture was stirred for 7 days at 4 °C. The reaction mixture was purified by a reversed-phase HPLC (0.1% AcOH-acetonitrile) to give 4.2 mg of the title compound.

Analytical HPLC: 18.90 min (For the condition, see: Example 119.)

Example 122: 1-Naphthoxyacetyl-Mta-(2S,3S)-AHPBA-Pro-NH-tBu

55 [Process 1] Boc-Mta-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 20 mg of the compound obtained by Example 55 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with

6.2 μ l of triethylamine under ice cooling. To the neutralized solution, 11 mg of Boc-methylthioalanine, 20 mg of Bop reagent and 12.4 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture treated similarly to that in Example 46 to give 24 mg of the title compound.
TLC: Rf 0.37 (chloroform : methanol = 9:1)

5

[Process 2] 1-Naphthoxyacetyl-Mta-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 24 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3) in the presence of 12 μ l of anisole, and the obtained product was dissolved in 3 ml of DMF and neutralized with 5.9 μ l of triethylamine under ice cooling. To the neutralized solution, 8.6 mg of 1-naphthoxyacetic acid, 18.8 mg of Bop reagent and 11.8 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give the crude compound mentioned above. In methanol, the crude product was dissolved, fractionated by a reversed-phase HPLC and lyophilized to give 6.6 mg of the title compound.
Analytical HPLC: 29.52 min (For the condition, see: Example 35.)
FAB-MS: 649 (M+1)

Example 123: 1-Naphthylaminoacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-tBu.AcOH

20 [Process 1] 1-Naphthylaminoacetic acid

In 5 ml of THF, 500 mg of 1-naphthylamine was added, then 168 mg of sodium hydride (60% in oil) was added and the resultant mixture was stirred for 30 min under ice cooling. To the reaction mixture, 0.16 ml of ethyl bromoacetate was added and the mixture was refluxed for 5 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was re-dissolved in ethyl acetate. The obtained solution was washed with 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and subjected to a silica gel column chromatography (n-hexane:ethyl acetate = 10:1) to give 720 mg of ethyl 1-naphthylaminoacetate. In 10 ml of ethanol, 460 mg of the ester was dissolved, 3.78 ml of 1N-NaOH aqueous solution was added and the resultant mixture was stirred for 1 hr. The reaction mixture was evaporated under reduced pressure, neutralized by the addition of 1N-HCl and extracted with ethyl acetate. The extract was washed with saturated sodium chloride aqueous solution and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and crystallized by the treatment with ether to give 188 mg of the title compound.

35 TLC: Rf 0.46 (chloroform : methanol:acetic acid = 9:1:0.5)

[Process 2] 1-Naphthylaminoacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-tBu.AcOH

Deprotection of 20 mg of the compound obtained by Example 90 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 4.7 μ l of triethylamine under ice cooling. To the neutralized solution, 8.4 mg of 1-naphthylaminoacetic acid, 15 mg of Bop reagent and 9.5 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was re-dissolved in ethyl acetate. The obtained solution was washed with 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and subjected to a silica gel column chromatography (chloroform : methanol = 20:1) and treated with ether to give 20 mg of the crude compound mentioned above. In methanol, 6 mg of the crude crystals were dissolved, fractionated by a reversed-phase HPLC (0.1% acetic acid-acetonitrile system), lyophilized to give 3.3 mg of the title compound.

50 Analytical HPLC: 24.81 min (For the condition, see: that in example 35.)
FAB-MS: 680 (M+1)

Example 124: 1-Naphthylaminoacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-tBu.AcOH

55 The above mentioned compound was obtained by a similar method of Example 123 [process 2].
Analytical HPLC: 27.08 min (For the condition, see: that in example 35.)
FAB-MS: 698 (M+1)

Example 125: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-C(CH₃)₂-CH₂OH[Process 1] Boc-Thz-NH-C(CH₃)₂-CH₂OH

In a methylene chloride solution containing 0.30 g of Boc-Thz-OH, 0.12 ml of 2-amino-2-methyl-1-propanol and 0.29 g of EDC hydrochloride were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 33 (Process 3) to give 190 mg of the title compound.

TLC: Rf 0.87 (chloroform : methanol:water = 8:3:1, lower layer)

[Process 2] Boc-(2S,3S)-AHPBA-Thz-NH-C(CH₃)₂-CH₂OH

To 40 mg of the protected peptide obtained by the [process 1], 5 ml of trifluoroacetic acid was added and the resultant mixture was stirred for 60 min at room temperature. The reaction mixture was evaporated under reduced pressure, and the resultant residue was washed with n-hexane and redissolved in 5 ml of DMF and neutralized with 19 μ l of triethylamine under ice cooling. To the neutralized solution, 63 mg of Boc-(2S,3S)-AHPBA-OH.DCHA, 58 mg of Bop reagent and 36 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 51 mg of the title compound.

TLC: Rf 0.75 (chloroform : methanol:water = 8:3:1, lower layer)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Thz-NH-C(CH₃)₂-CH₂OH

Deprotection of 51 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in 5 ml of DMF and neutralized with 14 μ l of triethylamine under ice cooling. To the neutralized solution, 26 mg of Boc-methanesulfonylalanine, 45 mg of Bop reagent and 28 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 to give 31 mg of the title compound.

TLC: Rf 0.81 (chloroform : methanol:water = 8:3:1, lower layer)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-C(CH₃)₂-CH₂OH

Deprotection of 31 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 7 μ l of triethylamine under ice cooling. To the neutralized solution, 9.7 mg of 1-naphthoxyacetic acid, 21.1 mg of Bop reagent and 13.3 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 122 to give 10.6 mg of the title compound.

Analytical HPLC: 22.88 min (For the condition, see: that in example 35.)

FAB-MS: 715 (M+1)

Example 126: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-C(CH₃)(CH₂OH)₂[Process 1] Boc-Pro-NH-C(CH₃)(CH₂OH)₂

In a methylene chloride solution containing 0.20 g of Boc-Pro-OH, 0.49 g of 2-amino-2-methyl-1,3-propanediol and 0.89 g of EDC hydrochloride were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 51 (Process 1) without filtration to give 0.36 g of the title compound.

TLC: Rf 0.48 (chloroform : methanol:acetic acid = 9:1:0.5)

[Process 2] Boc-(2S,3S)-AHPBA-Pro-NH-C(CH₃)(CH₂OH)₂

Deprotection of 50 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in 5 ml of DMF and neutralized with 22 μ l of triethylamine under ice cooling. To the neutralized solution, 75 mg of Boc-(2S,3S)-AHPBA-OH.DCHA, 70 mg of Bop reagent and 22 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 42 mg of the title compound.

TLC: Rf 0.74 (chloroform : methanol:water = 8:3:1, lower layer)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Pro-NH-C(CH₃)(CH₂OH)₂

Deprotection of 42 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in 5 ml of DMF and neutralized with 12 μ l of triethylamine under ice cooling. To the neutralized solution, 23 mg of Boc-methanesulfonylalanine, 38 mg of Bop reagent and 12 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 25 mg of the title compound. TLC: Rf 0.63 (chloroform : methanol:water = 8:3:1, lower layer)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-C(CH₃)(CH₂OH)₂

Deprotection of 25 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 5.4 μ l of triethylamine under ice cooling. To the neutralized solution, 7.8 mg of 1-naphthoxyacetic acid, 17.1 mg of Bop reagent and 10.8 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 122 to give 4.5 mg of the title compound. Analytical HPLC: 19.37 min (For the condition, see: that in example 35.) FAB-MS: 713 (M+1)

Example 127: 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Thz-piperidine

[Process 1] Boc-Thz-piperidine

In a methylene chloride solution containing 300 mg of Boc-Thz-OH, 358 μ l of triethylamine, 358 mg of 2-chloro-1, 3-dimethylimidazolidinium hexafluorophosphate and 153 μ l of piperidine were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 33 (Process 3) to give 300 mg of the title compound. TLC: Rf 0.41 (chloroform : methanol = 40:1)

[Process 2] Boc-(2S,3S)-AHPBA-Thz-piperidine

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 10 ml of methylene chloride and neutralized with 46 μ l of triethylamine under ice cooling. To the neutralized solution, 159 mg of Boc-(2S,3S)-AHPBA-OH.DCHA, 147 mg of Bop reagent and 46 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 to give 131 mg of the title compound. TLC: Rf 0.59 (chloroform : methanol = 9:1)

[Process 3] Boc-Asn-(2S,3S)-AHPBA-Thz-piperidine

Deprotection of 103 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 10 ml of DMF and neutralized with 30 μ l of triethylamine under ice cooling. To the neutralized solution, 114 mg of Boc-Asn-ONp, 50 mg of HOBt, 36 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was mixed with 5% sodium hydrogencarbonate aqueous solution. The obtained solid was subjected to a silica gel column chromatography (chloroform : methanol = 10:1) to give 65 mg of the title compound. TLC: Rf 0.69 (chloroform : methanol:water = 8:3: 1, lower layer)

[Process 4] 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Thz-piperazine

Deprotection of 65 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 8 ml of DMF and neutralized with 15 μ l of triethylamine under ice cooling. To the neutralized solution, 23 mg of 1-naphthoxyacetic acid, 49 mg of Bop reagent and 30 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was mixed with 5% sodium hydrogen carbonate aqueous solution to give precipitates. The formed precipitates were collected, washed with water and dried in vacuo to give 63 mg of the crude product. In methanol, 25 mg of the crude product was dissolved,

fractionated by a reversed-phase HPLC and lyophilized to give 6.8 mg of the title compound.
 Analytical HPLC: 20.42 min (For the condition, see: that in example 35.)
 FAB-MS: 676 (M+1)

5 Example 128: 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Thz-NH-cyclopentyl

[Process 1] Boc-Thz-NH-cyclopentyl

10 In a methylene chloride solution containing 200 mg of Boc-Thz-OH, 238 μ l of triethylamine, 379 mg of Bop reagent, and 102 μ l of cyclopentylamine were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 28 (Process 3) to give 235 mg of the title compound.

15 [Process 2] Boc-(2S,3S)-AHPBA-Thz-NH-cyclopentyl

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 10 ml of methylene chloride and neutralized with 46 μ l of triethylamine under ice cooling. To the neutralized solution, 159 mg of Boc-(2S,3S)-AHPBA-OH DCHA salt, 147 mg of Bop reagent and 46 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 46 to give 50 mg of the title compound.
 20 TLC: Rf 0.59 (chloroform : methanol = 9:1)

[Process 3] Boc-Asn-(2S,3S)-AHPBA-Thz-NH-cyclopentyl

25 Deprotection of 50 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 5 ml of DMF and neutralized with 15 μ l of triethylamine under ice cooling. To the neutralized solution, 56 mg of Boc-Asn-ONp, 24 mg of HOBT and 17 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 20 mg of the title compound.
 30 TLC: Rf 0.66 (chloroform : methanol:water = 8:3:1, lower layer)

[Process 4] 1-Naphthoxyacetyl-Asn-(2S,3S)-AHPBA-Thz-NH-cyclopentyl

The compound mentioned above was obtained by a similar method to that in Example 127, [process 4].
 35 Analytical HPLC: 24.13 min (For the condition, see: that in Example 35.)
 FAB-MS: 676 (M+1)

Example 129: m-Phenylphenoxyacetyl-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu

40 The compound mentioned above was obtained by a similar method to that in Example 119.
 Analytical HPLC: 29.01 min (For the condition, see: that in Example 119.)
 FAB-MS: 721 (M+1)

45 Example 130: 5-Isoquinolyloxyacetyl-Mta-(2S,3S)-AHPBA-Dtc-NH-tBu.AcOH

The compound mentioned above was obtained by a similar method to that in Example 123 (Process 2) using the compounds obtained in Example 119 (Process 1) and Example 115 (Process 1).
 Analytical HPLC: 18.00 min (For the condition, see: that in example 35.)
 FAB-MS: 696 (M+1)
 50 ¹H NMR (DMSO-d₆, 500 MHz): Fig. 5

Example 131: 2-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-tBu

55 Deprotection of 23 mg of the compound obtained by Example 90 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 5.4 μ l of triethylamine under ice cooling. To the neutralized solution, 8 mg of 2-naphthoxyacetic acid, 17 mg of Bop reagent and 11 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 30 (Process 4) and treated with hexane to give 22 mg of the

crude compound mentioned above. In methanol, 22 mg of the crude crystals were dissolved and, fractionated by a reversed-phase HPLC and lyophilized to give 11.8 mg of the title compound.

TLC: Rf 0.88 (chloroform : methanol = 9:1)

Analytical HPLC: 25.39 min (For the condition, see: that in example 35.)

FAB-MS: 681 (M+1)

Example 132: 1-Naphthoxyacetyl-Hse-(2S,3S)-AHPBA-Thz-NH-tBu

[Process 1] Boc-Hse-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 21 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 6.3 μ l of triethylamine under ice cooling. To the neutralized solution, 18 mg of Boc-Hse-OH.DCHA, 20 mg of Bop reagent and 6.3 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2), except for the chromatography solvent (chloroform : methanol = 40:1), to give 20 mg of the title compound.

TLC: Rf 0.83 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Hse-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 20 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 4.9 μ l of triethylamine under ice cooling. To the neutralized solution, 8 mg of 1-naphthoxyacetic acid, 16 mg of Bop reagent and 9.8 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in the process 1 to give 22 mg of the crude compound mentioned above. In methanol, the crude product was dissolved, fractionated by a reversed-phase HPLC and lyophilized to give 6.1 mg of the title compound.

TLC: Rf 0.57 (chloroform : methanol = 9:1)

Analytical HPLC: 21.31 min (For the condition, see: that in example 35.)

FAB-MS: 651 (M+1)

Example 133: 1-Naphthoxyacetyl-Thr-(2S,3S)-AHPBA-Thz-NH-tBu

[Process 1] Boc-Thr-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 19 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 4.3 μ l of triethylamine under ice cooling. To the neutralized solution, 9 mg of Boc-Thr-OH, 18 mg of Bop reagent and 6.2 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 24 mg of the title compound.

TLC: Rf 0.66 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Thr-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 29 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 7.1 μ l of triethylamine under ice cooling. To the neutralized solution, 11 mg of 1-naphthoxyacetic acid, 23 mg of Bop reagent and 14.2 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give 6.7 mg of the title compound.

TLC: Rf 0.66 (chloroform : methanol = 9:1)

Analytical HPLC: 26.32 min (For the condition, see: that of Example 35.)

FAB-MS: 651 (M+1)

Example 134: 1-Naphthoxyacetyl-Tle-(2S,3S)-AHPBA-Thz-NH-tBu

[Process 1] Boc-Tle-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 39 mg of the compound obtained by Example 82 (Process 2) was performed similarly to

that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 11.6 μ l of triethylamine under ice cooling. To the neutralized solution, 19.4 mg of Boc-Tle-OH, 37 mg of Bop reagent and 23.3 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 17 mg of the title compound.

TLC: Rf 0.94 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Tle-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 17 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 4.1 μ l of triethylamine under ice cooling. To the neutralized solution, 11 mg of 1-naphthoxyacetic acid, 13 mg of Bop reagent and 8.2 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 30 (Process 3) to give 15 mg of the crude compound. The crude product was dissolved in methanol, fractionated by a reversed-phase HPLC and lyophilized to give 2.3 mg of the title compound.

TLC: Rf 0.87 (chloroform : methanol = 9:1)

Analytical HPLC: 31.60 min (For the condition, see: that in example 35.)

FAB-MS: 663 (M+1)

Example 135: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-CH(CH₃)₂-CH₂OH

[Process 1] Boc-Valinol [Boc-Valol]

In 5 ml of 1,2-dimethoxyethane (DME), 1.086 g of Boc-Val-OH was dissolved and 550 μ l of N-methylmorpholine and 650 μ l of isobutyl chloroformate were successively added dropwise at -15 °C. After stirring for 1 min, N-methylmorpholine hydrochloride was filtered off and washed twice with 2.5 ml each of DME. The filtrate and washings were combined and a solution of 284 mg of sodium borohydride in 2.5 ml of water was added in one portion. After 30 sec, 125 ml of water was added and the mixture was extracted with 25 ml of ethyl acetate and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure to give 879 mg of the title compound.

TLC: Rf 0.52 (chloroform : methanol = 20:1)

[Process 2] Boc-Thz-Valol

Deprotection of 94 mg of the compound obtained by the process 1 was performed similarly to that in Example 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 88.9 μ l of triethylamine under ice cooling. To the neutralized solution, 164 mg of Boc-Thz-OH, 108 mg of HOBt and 147 mg of EDC hydrochloride were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 50 mg of the title compound.

TLC: Rf 0.60 (chloroform : methanol = 9:1)

[Process 3] Boc-(2S,3S)-AHPBA-Thz-Valol

Deprotection of 50 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 21.8 μ l of triethylamine under ice cooling. To the neutralized solution, 75 mg of Boc-(2S,3S)-AHPBA-OH.DCHA, 70 mg of Bop reagent and 43.6 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 30 (Process 4) to give 39 mg of the title compound.

TLC: Rf 0.45 (chloroform : methanol = 9:1)

[Process 4] Boc-Msa-(2S,3S)-AHPBA-Thz-Valol

Deprotection of 39 mg of the compound obtained by the process 3 was performed similarly to that in Example 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 10.9 μ l of triethylamine under ice cooling. To the neutralized solution, 22 mg of Boc-Msa-OH, 35 mg of Bop reagent and 21.9 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 25 mg of the title compound.

TLC: Rf 0.83 (chloroform : methanol = 9:1)

[Process 5] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-Valol

Deprotection of 25 mg of the compound obtained by the process 4 was performed similarly to that in Example 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 5.4 μ l of triethylamine under ice cooling. To the neutralized solution, 8 mg of 1-naphthoxyacetic acid, 18 mg of Bop reagent and 10.8 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give 2.8 mg of the title compound.

TLC: Rf 0.47 (chloroform : methanol = 9:1)

Analytical HPLC: 24.06 min (For the condition, see: that of example 35)

FAB-MS: 729 (M+1)

Example 136: 2-Benzofurancarboxyl-Msa-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 52 mg of the compound obtained by Example 100 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 11.8 μ l of triethylamine under ice cooling. To the neutralized solution, 14 mg of 2-benzofurancarboxylic acid, 38 mg of Bop reagent and 23.5 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give 1.9 mg of the title compound.

TLC: Rf 0.64 (chloroform : methanol = 9:1)

Analytical HPLC: 24.44 min (For the condition, see: that in example 35.)

FAB-MS: 659 (M+1)

Example 137:

1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-CH(CH₃)-(C₂H₅)-CH₂OH[Process 1] Boc-Isoleucinol [Boc-Ileol]

In 5 ml of 1,2-dimethoxyethane (DME), 1.201 g of Boc-Ile-OH.1/2H₂O was dissolved and 550 μ l of N-methylmorpholine and 650 μ l of isobutyl chloroformate were successively added dropwise at -15 °C. After stirring for 1 min, the formed N-methylmorpholine hydrochloride was filtered off and washed twice with 2.5 ml each of DME. The filtrate and washings were combined and 284 mg of sodium borohydride in 2.5 ml of water was added in one portion. After 30 sec, 125 ml of water was added and the mixture was extracted with 25 ml of ethyl acetate and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure to give 1.040 g of the title compound.

TLC: Rf 0.46 (chloroform : methanol = 20:1)

[Process 2] Boc-Thz-Ileol

Deprotection of 127 mg of the compound obtained by the process 1 was performed similarly to that in Example 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 81.2 μ l of triethylamine under ice cooling. To the neutralized solution, 136 mg of Boc-Thz-OH, 258 mg of Bop reagent and 162 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 134 mg of the title compound.

TLC: Rf 0.39 (chloroform : methanol = 20:1)

[Process 3] Boc-(2S,3S)-AHPBA-Thz-Ileol

Deprotection of 134 mg of the compound obtained by the process 2 was performed similarly to that in Example 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 56 μ l of triethylamine under ice cooling. To the neutralized solution, 119 mg of Boc-(2S,3S)-AHPBA-OH, 178 mg of Bop reagent and 112 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 30 (Process 4) to give 54 mg of the title compound.

TLC: Rf 0.37 (chloroform : methanol = 20:1)

[Process 4] Boc-Msa-(2S,3S)-AHPBA-Thz-Ileol

Deprotection of 54 mg of the compound obtained by the process 3 was performed similarly to that in Example 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 14.7 μ l of triethylamine under ice cooling. To the neutralized solution, 29 mg of Boc-Msa-OH, 47 mg of Bop reagent and 29.5 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 22 mg of the title compound. TLC: Rf 0.18 (chloroform : methanol = 20:1)

[Process 5]: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-Ileol

Deprotection of 22 mg of the compound obtained by the process 4 was performed similarly to that in Example 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 4.6 μ l of triethylamine under ice cooling. To the neutralized solution, 7 mg of 1-naphthoxyacetic acid, 15 mg of Bop reagent and 9.3 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and dissolved in ethyl acetate. The solution was washed with 5% citric acid aqueous solution, 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure to give 45 mg of a crude product. The crude product was dissolved in methanol, fractionated by a reversed-phase HPLC and lyophilized to give 7.9 mg of the title compound. TLC: Rf 0.41 (chloroform : methanol = 20:1)

Analytical HPLC: 21.54 min (For the condition, see: that of example 35)
FAB-MS: 743(M+1)

Example 138:

2-Quinolinecarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 18 mg of the compound obtained by Example 80 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 4.5 μ l of triethylamine under ice cooling. To the neutralized solution, 7 mg of 2-quinolinecarboxylic acid, 17 mg of Bop reagent and 9.8 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 118 to give 6.1 mg of the title compound. TLC: Rf 0.89 (chloroform : methanol = 9:1)

Analytical HPLC: 20.30 min (For the condition, see: that in example 35.)

FAB-MS: 603 (M+1)

Example 139: 1-Naphthoxyacetyl-Asp(NHNH₂)-(2S,3S)-AHPBA-Pro-NH-tBu.AcOH[Process 1] Boc-Aso(OBzl)-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 25 mg of the compound obtained by Example 55 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 7.8 μ l of triethylamine under ice cooling. To the neutralized solution, 20 mg of Boc-Asp(OBzl)-OH, 27 mg of Bop reagent and 17.1 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 23 mg of the title compound. TLC: Rf 0.84 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Asp(OBzl)-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 23 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 4.9 μ l of triethylamine under ice cooling. To the neutralized solution, 9 mg of 1-naphthoxyacetic acid, 19 mg of Bop reagent, 11.8 μ l of triethylamine and 7 mg of HOBt were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in ethyl acetate. The obtained solution was washed with 5% citric acid aqueous solution, 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure to give 24 mg of the title compound. TLC: Rf 0.86 (chloroform : methanol = 9:1)

[Process 3] 1-Naphthoxyacetyl-Asp(NHNH₂)-(2S,3S)-AHPBA-Pro-NH-tBu.AcOH

In 3 ml of methanol, 24 mg of the compound obtained by the process 2 was dissolved and 20 μ l of hydrazine hydrate was added and the resultant reaction mixture was stirred for 15 hr. The reaction mixture was evaporated under reduced pressure and the residue was subjected to a silica gel column chromatography (chloroform : methanol = 40:1) to give 28 mg of the crude product. In methanol, 10 mg of the crude product was desolved, fractionated by a reversed-phase HPLC [0.1% acetic acid (aq)-acetonitrile], lyophilized to give 2.5 mg of the title compound.

TLC: Rf 0.44 (chloroform : methanol = 9:1)

Analytical HPLC: 21.98 min (For the condition, see: Example 35).

FAB-MS: 661 (M+1)

Example 140: 1-Isoquinolinecarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu.AcOH

Deprotection of 19 mg of the compound obtained by Example 80 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 4.7 μ l of triethylamine under ice cooling. To the neutralized solution, 6 mg of 1-isoquinolinecarboxylic acid, 15 mg of Bop reagent and 9.4 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was evaporated under reduced pressure and the resultant residue was re-dissolved in ethyl acetate. The obtained solution was washed with 5% sodium hydrogencarbonate aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and subjected to a silica gel column chromatography (chloroform : methanol = 40:1) to give 19 mg of the crude compound. In methanol, 10 mg of the crude compound was dissolved, fractionated by a reversed-phase HPLC [0.1% acetic acid (aq)-acetonitrile system] and lyophilized to give 7.4 mg of the title compound.

TLC: Rf 0.38 (chloroform : methanol = 9:1)

Analytical HPLC: 19.33 min (For the condition, see: Example 35.)

FAB-MS: 603 (M+1)

Example 141: 1-Naphthalenesulfonyl-Asn-(2S,3S)-AHPBA-Pro-NH-tBu

Deprotection of 21 mg of the compound obtained by Example 80 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 5.2 μ l of triethylamine under ice cooling. To the neutralized solution, 9 mg of 1-naphthalenesulfonyl chloride and 5.7 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give 6.7 mg of the title compound.

TLC: Rf 0.42 (chloroform : methanol = 9:1)

Analytical HPLC: 22.40 min (For the condition, see: Example 35.)

FAB-MS: 652(M+1)

Example 142: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-tAmyl[Process 1] Boc-Thz-NH-tAmyl

In a methylene chloride solution containing 200 mg of Boc-Thz-OH, 100 μ l of tert-amylamine and 196 mg of EDC hydrochloride were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2) to give 167 mg of the title compound.

TLC: Rf 0.76 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-Thz-NH-tAmyl

Deprotection of 63 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 29 μ l of triethylamine under ice cooling. To the neutralized solution, 100 mg of Boc-(2S,3S)-AHPBA-OH.DCHA, 93 mg of Bop reagent, and 29 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 51 mg of the title compound.

TLC: Rf 0.71 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Thz-NH-tAmyl

Deprotection of 51 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 14.8 μ l of triethylamine under ice cooling. To the neutralized solution, 29 mg of Boc-Msa-OH, 47 mg of Bop reagent, and 29.6 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 47 mg of the title compound.
TLC: Rf 0.64 (chloroform : methanol = 9:1)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-tAmyl

Deprotection of 47 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 10.4 μ l of triethylamine under ice cooling. To the neutralized solution, 15 mg of 1-naphthoxy acetic acid, 33 mg of Bop reagent, and 20.7 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give 6.7 mg of the title compound.
TLC: Rf 0.39 (chloroform : methanol = 9:1)
Analytical HPLC: 28.66 min (For the condition, see: Example 35.)
FAB-MS: 713 (M+1)

Example 143: 2-Biphenylcarbonyl-Msa-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 146 mg of the compound obtained by Example 100 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 33 μ l of triethylamine under ice cooling. To the neutralized solution, 47 mg of 2-biphenylcarboxylic acid, 105 mg of Bop reagent, and 65.9 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 102 mg of the crude compound. The crude compound was dissolved in methanol and subjected to a reversed-phase HPLC (water-acetonitrile system), fractionated, purified and lyophilized to give the title compound.
TLC: Rf 0.64 (chloroform : methanol = 9:1)
Analytical HPLC: 23.30 min (For the condition, see: Example 35.)
FAB-MS: 696 (M+1)

Example 144: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-3Dic-NH-tBu[Process 1] Boc-(DL)-3Dic-OH

In an ethanol solution containing 2.0 g of N-(tert-butoxycarbonyl)-DL-1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid, 5% Rh/Al₂O₃ was added and the resultant mixture was stirred for 3 days in a hydrogen gas atmosphere (4.5 kg/cm²). The reaction mixture was filtered and the filtrate was evaporated under reduced pressure. The resultant residue was crystallized by the treatment with ether-hexane to give 1.5 g of the title compound.
TLC: Rf 0.56 (chloroform : methanol:acetic acid = 9:1:0.5)

[Process 2] Boc-(DL)-3Dic-NH-tBu

In a dichloromethane solution containing 0.2 g of the protected amino acid obtained by the process 1, 60 mg of tert-butylamine and 0.12 g of HOBt and 0.16 g of EDC hydrochloride were added under ice-cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was evaporated under reduced pressure and the resultant residue was re-dissolved in ethyl acetate. The obtained solution was washed with 5% sodium hydrogencarbonate aqueous solution, 10% citric acid aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and crystallized from ether-hexane to give 0.21 g of the title compound.
TLC: Rf 0.88 (chloroform : methanol:acetic acid = 9:1:0.5)

[Process 3] Boc-(2S,3S)-AHPBA-(DL)-3Dic-NH-tBu

Deprotection of 210 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in dichloromethane and neutralized with 90

μl of triethylamine under ice cooling. To the neutralized solution, 0.18 g of Boc-(2S, 3S)-AHPBA-OH and 0.33 g of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in the process 2 to give 150 mg of the title compound.
TLC: Rf 0.63 (chloroform : methanol = 40:1)

5 [Process 4] Boc-Msa-(2S,3S)-AHPBA-(DL)-3Dic-NH-tBu

Deprotection of 150 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in DMF and neutralized with 40 μl of triethylamine under ice cooling. To the neutralized solution, 72 mg of Boc-Msa-OH and 146 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in the process 2 to give 0.11 g of the title compound.
TLC: Rf 0.16 (chloroform : methanol:acetic acid = 9:1:0.5)

15 [Process 5] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-3Dic-NH-tBu

Deprotection of 110 mg of the compound obtained by the process 4 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 20 μl of triethylamine under ice cooling. To the neutralized solution, 30 mg of 1-naphthoxyacetic acid and 60 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 8 mg of the title compound.
FAB-MS: -749 (M+1)

25 Example 145: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-1Dic-NH-tBu

[Process 1] Boc-(DL)-1Dic-OH

In an acetic acid solution containing 2.0 g of isoquinoline-1-carboxylic acid, 5% Rh/Al₂O₃ was added and the resultant mixture was stirred for 3 days in a hydrogen gas atmosphere (4.5 kg/cm²). The reaction mixture was filtered and the filtrate was evaporated under reduced pressure. The resultant residue was tert-butoxycarbonylated, dissolved in ethanol, and the resultant mixture was stirred with 5% Rh/Al₂O₃ for 3 days in a hydrogen gas atmosphere (4.5 kg/cm²). The reaction mixture was treated similarly to that in Example 144 (Process 1) to give 0.8 g of the title compound.

TLC: Rf 0.71 (chloroform : methanol:acetic acid = 9:1:0.5)

35 [Process 2] Boc-(DL)-1Dic-NH-tBu

In a dichloromethane solution containing 0.29 g of the protected amino acid obtained by the process 1, 90 mg of tert-butylamine and 0.17 g of HOBt and 0.23 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.13 g of the title compound.

TLC: Rf 0.76 (chloroform : methanol:acetic acid = 9:1:0.5)

45 [Process 3] Boc-(2S,3S)-AHPBA-(DL)-1Dic-NH-tBu

Deprotection of 130 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in dichloromethane and neutralized with 50 μl of triethylamine under ice cooling. To the neutralized solution, 0.1 g of Boc-(2S, 3S)-AHPBA-OH and 0.18 g of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 90 mg of the title compound.
TLC: Rf 0.68 (chloroform : methanol = 40:1)

55 [Process 4] Boc-Msa-(2S,3S)-AHPBA-(DL)-1Dic-NH-tBu

Deprotection of 90 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in DMF and neutralized with 20 μl of triethylamine under ice cooling. To the neutralized solution, 42 mg of Boc-Msa-OH and 80 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was

treated similarly to that in Example 144 (Process 2) to give 90 mg of the title compound.
TLC: Rf 0.83 (chloroform : methanol:acetic acid = 9:1:0.5)

[Process 5] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-1Dic-NH-tBu

Deprotection of 90 mg of the compound obtained by the process 4 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 35 μ l of triethylamine under ice cooling. To the neutralized solution, 30 mg of 1-naphthoxyacetic acid and 60 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 3 mg of the title compound.
FAB-MS: 749 (M+1)

Example 146: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Oic-NH-tBu

[Process 1] Boc-Oic-OH

In an acetic acid solution containing 2.0 g of L-indoline-2-carboxylic acid, 5% Rh/Al₂O₃ was added and the resultant mixture was stirred for 3 days in a hydrogen gas atmosphere 4.5 kg/cm²). The reaction mixture was filtered and the filtrate was evaporated under reduced pressure. The resultant residue was tert-butoxycarbonylated to give 0.6 g of the title compound.

[Process 2] Boc-Oic-NH-tBu

In a dichloromethane solution containing the protected amino acid obtained by the process 1, tert-butylamine, HOBT and EDC hydrochloride were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give the title compound.

TLC: Rf 0.89 (chloroform : methanol = 9:1)

[Process 3] Boc-(2S,3S)-AHPBA-Oic-NH-tBu

Deprotection of 63 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in dichloromethane and neutralized with 20 μ l of triethylamine under ice cooling. To the neutralized solution, 86 mg of Boc-(2S, 3S)-AHPBA-OH and 93 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 10 mg of the title compound.
TLC: Rf 0.35 (hexane:ether = 2:1)

[Process 4] Boc-Msa-(2S,3S)-AHPBA-Oic-NH-tBu

Deprotection of 10 mg of the compound obtained by the process 3 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in DMF and neutralized with 3 μ l of triethylamine under ice cooling. To the neutralized solution, 10 mg of Boc-Msa-OH and 12 mg of Bop reagent were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 46 to give 20 mg of the title compound.
TLC: Rf 0.76 (chloroform : methanol = 9:1)

[Process 5] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Oic-NH-tBu

Deprotection of 20 mg of the compound obtained by the process 4 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 3 μ l of triethylamine under ice cooling. To the neutralized solution, 4 mg of 1-naphthoxyacetic acid and 11 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 1 mg of the title compound.

Analytical HPLC: 27.47 min (For the condition, see: Example 35.)

FAB-MS: 735 (M+1)

Example 147: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(o-OH)[Process 1] Boc-Pro-NH-Ph(o-OH)

5 In a dichloromethane solution containing 1.07 g of Boc-Pro-OH, 0.55 g of *o*-aminophenol, 0.84 g of HOBt and 1.15 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.25 g of the title compound.

TLC: Rf 0.60 (chloroform : methanol = 9:1)

10 [Process 2] Boc-(2S,3S)-AHPBA-Pro-NH-Ph(o-OH)

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in dichloromethane and neutralized with 50 μ l of triethylamine under ice cooling. To the neutralized solution, 155 mg of Boc-(2S,3S)-AHPBA-OH and 175 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 55 (Process 3) to give 70 mg of the title compound.

TLC: Rf 0.51 (chloroform : methanol = 9:1)

20 [Process 3] Boc-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(o-OH)

Deprotection of 50 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in DMF and neutralized with 14 μ l of triethylamine under ice cooling. To the neutralized solution, 27 mg of Boc-Msa-OH and 53 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 20 mg of the title compound.

TLC: Rf 0.53 (chloroform : methanol = 9:1)

30 [Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(o-OH)

Deprotection of 20 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 4.2 μ l of triethylamine under ice cooling. To the neutralized solution, 6 mg of 1-naphthoxyacetic acid and 18 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 6 mg of the title compound.

Analytical HPLC: 25.83 min (For the condition, see: Example 35.)

FAB-MS: 717 (M+1)

40 Example 148: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(m-OH)[Process 1] Boc-Pro-NH-Ph(m-OH)

From 1.07 g of Boc-Pro-OH, and 0.55 g of *m*-aminophenol, 0.13 g of the title compound was synthesized by the similar method to Example 147 (Process 1).

45 TLC: Rf 0.54 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Pro-NH-Ph(m-OH)

From 0.13 g of the protected amino acid obtained by the process 1, 114 mg of the title compound was synthesized by the similar method to Example 147 (Process 2).

50 TLC: Rf 0.38 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(m-OH)

55 From 50 mg of the protected peptide obtained by the process 2, 60 mg of the title compound was synthesized by the similar method to Example 147 (Process 3)

TLC: Rf 0.45 (chloroform : methanol = 9:1)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(m-OH)

From 60 mg of the protected peptide obtained by the process 3, 5 mg of the title compound was synthesized by the similar method to Example 147 (Process 3).

5 Analytical HPLC: 24.23 min (For the condition, see: Example 35.)
FAB-MS: 717 (M+1)

Example 149: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(p-OH)

10 [Process 1] Boc-Pro-NH-Ph(p-OH)

From 1.07 g of Boc-Pro-OH and 0.55 g of p-aminophenol, 0.13 g of the title compound was synthesized by the similar method to Example 147 (Process 1)

TLC: Rf 0.72 (chloroform : methanol:H₂O = 8:3:1, lower layer)

15

[Process 2] Boc-(2S,3S)-AHPBA-Pro-NH-Ph(p-OH)

From 0.1 g of the protected amino acid obtained by the process 1, 151 mg of the title compound was synthesized by the similar method to Example 147 (Process 2)

20 TLC: Rf 0.50 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(p-OH)

25 From 50 mg of the protected peptide obtained by the process 2, 10 mg of the title compound was synthesized by the similar method to Example 147 (Process 3)

TLC: Rf 0.45 (chloroform : methanol = 9:1)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Pro-NH-Ph(p-OH)

30 From 10 mg of the protected peptide obtained by the process 3, 1 mg of the title compound was synthesized by the similar method to Example 147 (Process 4).

Analytical HPLC: 24.83 min (For the condition, see: Example 35.)

FAB-MS: 717 (M+1)

35 Example 150: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Hyp-NH-tBu

[Process 1] Boc-Hyp-NH-tBu

40 In a dichloromethane solution containing 5.1 g of N-Boc-hydroxyproline (Boc-Hyp-OH), 0.35 g of tert-butylamine, 7.4 g of HOBt and 6.0 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 114 (Process 2) to give 2.59 g of the title compound.

TLC: Rf 0.67 (chloroform : methanol = 9:1)

45 [Process 2] Boc-(2S,3S)-AHPBA-Hyp-NH-tBu

Deprotection of 170 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane and neutralized with 50 μ l of triethylamine under ice cooling. To the neutralized solution, 138 mg of Boc-(2S,3S)-AHPBA-OH and 200 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.13 g of the title compound.
50 TLC: Rf 0.41 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Hyp-NH-tBu

55

Deprotection of 100 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 30 μ l of triethylamine under ice cooling. To the neutralized solution, 59 mg of Boc-Msa-OH and 116 mg of Bop reagent

were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 33 mg of the title compound.

TLC: Rf 0.18 (chloroform : methanol = 9:1)

5 [Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Hyp-NH-tBu

Deprotection of 20 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 4 μ l of triethylamine under ice cooling. To the neutralized solution, 6 mg of 1-naphthoxyacetic acid and 18 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 1 mg of the title compound.

Analytical HPLC: 26.27 min (For the condition, see: Example 35.)

FAB-MS: 697 (M+1)

15 Example 151 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Hyp(Me)-NH-tBu

[Process 1] Boc-Hyp(Me)-NH-tBu

In a THF solution containing 0.6 g of the protected amino acid obtained by the Example 150, (Process 1), 94 mg of sodium hydride (60% in oil) was added under ice cooling and the resultant mixture was stirred for 1 hr at room temperature. Further, 2.0 ml of methyl iodide was added and the obtained reaction mixture was stirred for 3 hr at room temperature. To the reaction mixture, 5% potassium hydrogensulfate aqueous solution was added and extracted with ethyl acetate. The organic layer was washed with water and saturated sodium chloride aqueous solution, successively and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and treated with hexane to crystallize 0.4 g of the title compound.

TLC: Rf 0.74 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Hyp(Me)-NH-tBu

From 0.1 g of the protected amino acid obtained by the process 1, 0.14 g of the title compound was synthesized by the similar method to Example 150 (Process 2).

TLC: Rf 0.62 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Hyp(Me)-NH-tBu

From 0.14 g of the protected peptide obtained by the process 2, 0.14 g of the title compound was synthesized by the similar method to Example 150 (Process 3).

TLC: Rf 0.76 (chloroform : methanol = 9:1)

40 [Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Hyp(Me)-NH-tBu

From 20 mg of the protected peptide obtained by the process 3, 11 mg of the title compound was synthesized by the similar method to Example 150 (Process 4).

Analytical HPLC: 26.43 min (For the condition, see: Example 35.)

45 FAB-MS: 711 (M+1)

Example 152: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Hyp(Et)-NH-tBu

[Process 1] Boc-Hyp(Et)-NH-tBu —

In a THF solution containing 1.0 g of the protected amino acid obtained by the Example 150 (Process 1), 160 mg of sodium hydride (60% in oil) was added under ice cooling and the resultant mixture was stirred for 1 hr at room temperature. Further, 1 ml of ethyl bromide was added and stirred for 3 hr at room temperature the obtained reaction mixture was treated similarly to that in Example 151 (Process 1) to give 0.8 g of the title compound.

TLC: Rf 0.78 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Hyp(Et)-NH-tBu

From 0.8 g of the protected amino acid obtained by the process 1, 80 mg of the title compound was synthesized by the similar method to Example 150 (Process 2).

5 TLC: Rf 0.70 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Hyp(Et)-NH-tBu

10 From 80 mg of the protected peptide obtained by the process 2, 87 mg of the title compound was synthesized by the similar method to Example 150 (Process 3).

TLC: Rf 0.76 (chloroform : methanol = 9:1)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Hyp(Et)-NH-tBu

15 From 20 mg of the protected peptide obtained by the process 3, 2 mg of the title compound was synthesized by the similar method to Example 150 (Process 4).

Analytical HPLC: 27.42 min (For the condition, see: Example 35.)

FAB-MA: 725 (M+1)

20 Example 153: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Hyp(Allyl)-NH-tBu[Process 1] Boc-Hyp(Allyl)-NH-tBu

25 In a THF solution containing 1.0 g of the protected amino acid obtained by the Example 150 (Process 1), 160 mg of sodium hydride (60% in oil) was added under ice cooling and the resultant mixture was stirred for 1 hr at room temperature. Further, 0.5 ml of allyl bromide was added and stirred for 3 hr at room temperature the obtained reaction mixture was treated similarly to that in Example 151 (Process 1) to give 0.95 g of the title compound.

30 TLC: Rf 0.87 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Hyp(Allyl)-NH-tBu

From 0.13 g of the protected amino acid obtained by the process 1, 156 mg of the title compound was synthesized by the similar method to Example 150 (Process 2).

35 TLC: Rf 0.82 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Hyp(Allyl)-NH-tBu

40 From 50 mg of the protected peptide obtained by the process 2, 41 mg of the title compound was synthesized by the similar method to Example 150 (Process 3).

TLC: Rf 0.59 (chloroform : methanol = 9:1)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-(Allyl)-NH-tBu

45 From 21 mg of the protected peptide obtained by the process 3, 4 mg of the title compound was synthesized by the similar method to Example 150 (Process 4).

Analytical HPLC: 28.27 min (For the condition, see: Example 35.)

FAB-MS: 737 (M+1)

50 Example 154: 1-Naphthoxyacetyl-Mtv-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] N-Boc- β -(methylthio)valine [Boc-Mtv-OH]

55 In 70 ml of a mixture of 1N-NaOH-ethanol (1:1) solution containing 1.04 g of L-penicillamine, 0.48 ml of methyl iodide was added under ice cooling and the obtained reaction mixture was stirred overnight at room temperature. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in ethyl acetate, washed with 5% sodium hydrogensulfite aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was

evaporated under reduced pressure. The obtained residue was tert-butoxycarbonylated and 2.83 g of the title compound was obtained as its DCHA salt.

TLC: Rf 0.68 (chloroform : methanol:H₂O = 8:3:1, lower layer)

5 [Process 2] Boc-Mtv-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 50 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 14 μ l of triethylamine under ice cooling. To the neutralized solution, 45 mg of the protected amino acid DCHA salt obtained by the process 1 and 53 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 30 mg of the title compound.

TLC: Rf 0.86 (chloroform : methanol = 9:1)

15 [Process 3] 1-Naphthoxyacetyl-Mtv-AHPBA-Thz-NH-tBu

Deprotection of 30 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 7 μ l of triethylamine under ice cooling. To the neutralized solution, 10 mg of 1-naphthoxyacetic acid and 26 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 1 mg of the title compound.

Analytical HPLC: 33.23 min (For the condition, see: Example 35.)

FAB-MS: 695 (M+1)

25 Example 155: 1-Naphthoxyacetyl-Msv-(2S,3S)-AHPBA-Thz-NH-tBu

[Process 1] N-Boc- β -(methanesulfonyl)valine [Boc-Msv-OH]

In a chloroform solution containing 0.44 g of the protected amino acid obtained by the Example 154, (Process 1), 0.52 g of *m*-chloroperbenzoic acid was added under ice cooling and the reaction mixture was stirred for 2 hr at room temperature. The reaction mixture was mixed with methyl sulfide and filtered. DCHA was added to the filtrate, and the solution was evaporated under reduced pressure and crystallized by the addition of ether-hexane. The obtained solid was recrystallized from ether-hexane to give 0.23 g of the title compound as its DCHA salt.

TLC: Rf 0.33 (chloroform : methanol = 9:1)

[Process 2] Boc-Msv-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 50 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 14 μ l of triethylamine, 30 mg of the protected amino acid obtained by the process 1 and 53 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 20 mg of the title compound.

TLC: Rf 0.50 (chloroform : methanol = 9:1)

45 [Process 3] 1-Naphthoxyacetyl-Msv-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 20 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 4 μ l of triethylamine under ice cooling. To the neutralized solution, 6 mg of 1-naphthoxyacetic acid and 18 mg of Bop reagent were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 0.3 mg of the title compound.

Analytical HPLC: 28.96 min (For the condition, see: Example 35.)

FAB-MS: 727 (M+1)

Example 156: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-CH(C₆H₅)CH₂OH

[Process 1] N-Boc-Phenylglycinol [Boc-Phgol]

5 In a THF solution containing 0.30 g of lithium borohydride, 1.30 g of N-(tert-butoxycarbonyl)phenylglycine methyl ester was added under ice cooling. To the resultant solution, methanol was added dropwise under ice cooling and stirred overnight at room temperature. Water was added to the reaction mixture, extracted with ethyl acetate. The organic layer was washed with water and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and the obtained residue was subjected to a silica gel column chromatography (hexane:ether = 1:1) to give 0.41 g of the title compound. -
 10 TLC: Rf 0.11 (hexane:ether = 1:1)

[Process 2] Boc-Thz-Phgol

15 Deprotection of 240 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane and 0.14 ml of triethylamine, 0.23 g of Boc-Thz-OH, 0.17 g of HOBt and 0.23 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.15 g of the title compound.
 20 TLC: Rf 0.53 (chloroform : methanol = 9:1)

[Process 3] Boc-(2S,3S)-AHPBA-Thz-Phgol

25 Deprotection of 35 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 14 μ l of triethylamine under ice cooling. To the neutralized solution, 30 mg of Boc-(2S,3S)AHPBA-OH, 53 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 40 mg of the title compound.
 30 TLC: Rf 0.48 (chloroform : methanol = 9:1)

[Process 4] Boc-Msa-(2S,3S)-AHPBA-Thz-Phgol

35 Deprotection of 40 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 11 μ l of triethylamine under ice cooling. To the neutralized solution, 20 mg of Boc-Msa-OH, 40 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in, Example 93 (Process 3) to give 10 mg of the title compound.
 40 TLC: Rf 0.43 (chloroform : methanol = 9:1)

[Process 5] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-CH(C₆H₅)CH₂OH

45 Deprotection of 10 mg of the compound obtained by the process 4 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 1.5 μ l of triethylamine under ice cooling. To the neutralized solution, 3 mg of 1-naphthoxyacetic acid and 12 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 0.3 mg of the title compound.
 Analytical HPLC: 26.03 min (For the condition, see: Example 35.)
 FAB-MS: 763 (M+1)

Example 157: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-Phg-NH₂

[Process 1] Boc-Phg-NH₂

55 In a dichloromethane solution containing 4.3 g of N-tert-butoxycarbonyl)phenylglycine, 5 ml of ammonia water, 1.5 g of HOBt and 2.3 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.42 g of the title compound.

TLC: Rf 0.73 (chloroform : methanol = 5:1)

[Process 2] Boc-Thz-Phg-NH₂

Deprotection of 250 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in dichloromethane and 0.14 ml of triethylamine, 0.23 g of Boc-Thz-OH, 0.17 g of HOBt and 0.23 g of EDC hydrochloride were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.316 g of the title compound.

TLC: Rf 0.61 (chloroform : methanol = 9:1)

[Process 3] Boc-(2S,3S)-AHPBA-Thz-Phg-NH₂

Deprotection of 37 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in DMF and neutralized with 14 μ l of triethylamine under ice cooling. To the neutralized solution, 30 mg of Boc-(2S, 3S)-AHPBA-OH, 53 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 30 mg of the title compound.

TLC: Rf 0.58 (chloroform : methanol = 9:1)

[Process 4] Boc-Msa-(2S,3S)-AHPBA-Thz-Phg-NH₂

Deprotection of 30 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 8.4 μ l of triethylamine under ice cooling. To the neutralized solution, 16 mg of Boc-Msa-OH, 32 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 30 mg of the title compound.

TLC: Rf 0.47 (chloroform : methanol = 9:1)

[Process 5] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-Phg-NH₂

Deprotection of 30 mg of the compound obtained by the process 4 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 6 μ l of triethylamine under ice cooling. To the neutralized solution, 9 mg of 1-naphthoxy-acetic acid and 23 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 2 mg of the title compound.

Analytical HPLC: 23.79 min (For the condition, see: Example 35.)

FAB-MS: 776 (M+1)

Example 158: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-chex-ol

[Process 1] Boc-Thz-NH-chex-ol

In a dichloromethane solution containing 0.23 g of Boc-Thz-OH, 0.12 g of trans-4-aminocyclohexanol, 0.17 g of HOBt and 0.23 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.12 g of the title compound.

TLC: Rf 0.38 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Thz-NH-chex-ol

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in DMF and neutralized with 56 μ l of triethylamine. To the neutralized solution, 190 mg of Boc-(2S,3S)-AHPBA-OH and 221 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 120 mg of the title compound.

TLC: Rf 0.48 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Thz-NH-chex-ol

Deprotection of 50 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 14 μ l of triethylamine under ice cooling. To the neutralized solution, 27 mg of Boc-Msa-OH and 53 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 10 mg of the title compound.

TLC: Rf 0.56 (chloroform : methanol = 9:1)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-NH-chex-OH

Deprotection of 10 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 2 μ l of triethylamine under ice cooling. To the neutralized solution, 3 mg of 1-naphthoxy-acetic acid and 12 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 2 mg of the title compound.

Analytical HPLC: 25.58 min (For the condition, see: Example 35).

FAB-MS: 741 (M+1)

Example 159: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-Pip-O-CH₃[Process 1] Boc-Thz-(DL)-Pip-O-CH₃

In a dichloromethane solution containing 0.20 g of hydrochloride of methyl (DL)-pipercolinate, 0.17 ml of triethylamine, 0.28 g of Boc-Thz-OH, 0.20 g of HOBt and 0.28 g of EDC hydrochloride were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 139 (Process 2) to give 0.34 g of the title compound as oil.

TLC: Rf 0.83 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-(DL)-Pip-O-CH₃

Deprotection of 100 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in DMF and neutralized with 24 μ l of triethylamine under ice cooling. To the neutralized solution, 50 mg of Boc-(2S, 3S)-AHPBA-OH and 88 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 40 mg of the title compound.

TLC: Rf 0.58 (chloroform : methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Thz-(DL)-Pip-O-CH₃

Deprotection of 40 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 11 μ l of triethylamine under ice cooling. To the neutralized solution, 20 mg of Boc-Msa-OH and 40 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 10 mg of the title compound.

TLC: Rf 0.47 (chloroform : methanol = 9:1)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-Pip-O-CH₃

Deprotection of 20 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 3 μ l of triethylamine under ice cooling. To the neutralized solution, 4 mg of 1-naphthoxy-acetic acid and 10 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 2 mg of 1-naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-(D)-Pip-O-CH₃ and 1 mg of 1-naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-(L)-Pip-O-CH₃.

Analytical HPLC: 21.31, 27.22 min (For the condition, see: Example 35).

FAB-MS: 769 (M+1)

Example 160: 1-Naphthoxyacetyl-Phg-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] Boc-Phg-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 38 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and 11 μ l of triethylamine, 36 mg of Boc-Phg-OH and 44 mg of Bop reagent were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 10 mg of the title compound.

TLC: Rf 0.90 (chloroform : methanol = 9:1)

[Process 1] 1-Naphthoxyacetyl-Phg-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 10 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 3 μ l of triethylamine under ice cooling. To the neutralized solution, 3 mg of 1-naphthoxyacetic acid and 12 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 0.4 mg of the title compound.

Analytical HPLC: 26.12 min (For the condition, see: Example 35).

FAB-MS: 683 (M+1)

Example 161: 1-Naphthoxyacetyl-Ile-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] Boc-Ile-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 100 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and 29 μ l of triethylamine, 50 mg of Boc-Ile-OH and 106 mg of Bop reagent were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 10 mg of the title compound.

TLC: Rf 0.90 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Ile-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 10 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 37 μ l of triethylamine under ice cooling. To the neutralized solution, 3 mg of 1-naphthoxy-acetic acid and 12 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 3 mg of the title-compound.

Analytical HPLC: 31.15 min (For the condition, see: Example 35).

FAB-MS: 663 (M+1)

Example 162: 1-Naphthoxyacetyl-Mta-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] Boc-Mta-(2S, 3S)-AHPBA-Thz-NH-tBu

Deprotection of 100 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and 29 μ l of triethylamine, 50 mg of Boc-Ile-OH and 106 mg of Bop reagent were added under ice cooling and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 6.5 mg of the title compound.

TLC: Rf 0.90 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Mta-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 6.5 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 30 μ l of triethylamine under ice cooling. To the neutralized solution, 3 mg of 1-naphthoxy-acetic acid and 12 mg of Bop

reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 0.7 mg of the title compound.

Analytical HPLC: 30.54 min (For the condition, see: Example 35).

FAB-MS: 667 (M+1)

5

Example 163: 1-Naphthoxyacetyl-Thr(Me)-(2S,3S)-AHPBA-Thz-NH-tBu

[Process 1] Boc-Thr(Me)-OH

10 In a THF solution containing 0.8 g of Boc-Thr-OH, 100 mg of sodium hydride (60% in oil) was added under ice cooling and the resultant mixture was stirred for 30 min at room temperature. Further, 2.8 ml of methyl iodide was added and the obtained reaction mixture was stirred overnight at room temperature. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in ethyl acetate, washed with 5% sodium hydrogensulfite aqueous solution, water and saturated sodium chloride aqueous solution, suc-
15 cessively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure, dissolved in methanol, mixed with DCHA and reevaporated. Ether-hexane was added to the residue to give 0.55 g of the title compound as its DCHA salt.

TLC: Rf 0.63 (chloroform : methanol = 9:1)

20

[Process 2] Boc-Thr(Me)-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 100 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF, and 29 μ l of triethylamine, 50 mg of Boc-Thr(Me)-OH and 106 mg of Bop reagent were added and the resultant mixture was stirred over-
25 night at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 27.1 mg of the title compound.

TLC: Rf 0.50 (chloroform : methanol = 9:1)

[Process 3] 1-Naphthoxyacetyl-Thr(Me)-(2S,3S)-AHPBA-Thz-NH-tBu

30

Deprotection of 27.1 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product has dissolved in DMF and neutralized with 50 μ l of triethylamine under ice cooling. To the neutralized solution, 18 mg of 1-naphthoxy-acetic acid and 30 mg of Bop reagent were added and the resultant mixture was stirred overnight at room temperature. The reaction mix-
35 ture was treated similarly to that in Example 122 to give 3 mg of the title compound.

Analytical HPLC: 29.20 min (For the condition, see: Example 35).

FAB-MS: 665 (M+1)

Example 164: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pdp-NH-tBu

40

[Process 1] Benzyloxycarbonyl-Pdp-NH-tBu

In a dichloromethane solution containing 100 mg of 1-(Benzyloxycarbonyl)-4-phenyl-2, 5-dihydropyrrole-2-carboxylic acid [$C_6H_5-CH_2O-CO-Pdp-OH$], 43 μ l of triethyl-amine, 86 mg of 2-chloro-1, 3-dimethylimidazoli-
45 nium hexa-fluorophosphate and 64 μ l of tert-butylamine were added under ice cooling and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2) to give 66 mg of the title compound.

TLC: Rf 0.62 (chloroform : methanol = 40:1)

50

[Process 2] Boc-(2S,3S)-AHPBA-Pdp-NH-tBu

To 66 mg of the protected peptide obtained by the process 1, 3 ml of 30% HBr in acetic acid was added in the presence of 30 μ l of anisole and the mixture was stirred for 2 hr at room temperature. The reaction mixture was evaporated under reduced pressure and the resultant residue was redissolved in 3 ml of DMF, and neut-
55 ralized with 24 μ l of triethylamine under ice cooling. To the neutralized solution, 81 mg of Boc-(2S,3S)-AHPBA-OH.DCHA salt, 75 mg of Bop reagent and 24 μ l of triethylamine were added and the resultant mixture was stirred overnight. The reaction mixture was treated similarly to that in Example 30 (Process 4) to give 25 mg of the title compound.

TLC: Rf 0.71 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pdp-NH-tBu

Deprotection of 25 mg of the compound obtained by the process 2 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 7 μ l of triethylamine under ice cooling. To the neutralized solution, 28 mg of benzyloxycarbonyl-Asn-ONp, 11 mg of HOBt and 8 μ l of N-methylmorpholine were added and the resultant mixture was stirred for 14 hr. The reaction mixture was treated similarly to that in Example 101 (Process 2) to give 9.7 mg of the title compound.

Analytical HPLC: 25.30 min (For the condition, see: Example 35).

FAB-MS: 670 (M+1)

Example 165 1-Naphthoxyacetyl-Nva-(2S,3S)-AHPBA-Thz-NH-tBu

[Process 1] Boc-Nva-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 32 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF, and neutralized with 9.6 μ l of triethylamine under ice cooling. To the neutralized solution, 15 mg of N-Boc-norvaline (Boc-Nva-OH), 30 mg of Bop reagent and 19.2 μ l of triethylamine were added and the resultant mixture was stirred 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 25 mg of the title compound. TLC: Rf 0.93 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Nva-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 25 mg of the compound obtained by the process 1 was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 7.5 μ l of triethylamine under ice cooling. To the neutralized solution, 11 mg of 1-naphthoxyacetic acid, 24 mg of Bop reagent and 14.9 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 137 (Process 5) to give the title compound.

TLC: Rf 0.90 (chloroform : methanol = 9:1)

Analytical HPLC: 31.20 min (For the condition, see: Example 35).

FAB-MS: 649 (M+1)

Example 166: m-Isopropoxyphenoxyacetyl-Msa-(2S,3S)-AHPBA-Dtc-NH-tBu

[Process 1] m-Isopropoxyphenol [m-(iPro)-Ph-OH]

In 10 ml of THF, 1.5 g of resorcinol was dissolved and 2.24 ml of DBU was added under ice cooling. The resultant mixture was stirred for 10 min at room temperature. To the mixture, 1.92 ml of isopropyl bromide was added and refluxed for 2 hr. The reaction mixture was neutralized with acetic acid and evaporated under reduced pressure. The evaporated residue was redissolved in ethyl acetate and washed with 5% aqueous citric acid solution and saturated aqueous sodium chloride solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and the residue was subjected to a silica gel column chromatography (chloroform : methanol = 40:1) to give 466 mg of the title compound.

TLC: Rf 0.78 (chloroform:methanol = 9:1)

[Process 2] m-(iPro)-Ph-O-CH₂-CO₂C₂H₅

In 5 ml of THF, 466 mg of the product obtained by the process 1 and 0.67 ml methanol solution of sodium metanolate was added under ice cooling followed by stirring for 10 min. To the reaction mixture, 375 μ l of ethyl bromoacetate was added and the mixture was refluxed for 2 hr. The reaction mixture was neutralized with acetic acid and evaporated under reduced pressure. The obtained residue was redissolved in ethyl acetate and washed with 5% aqueous citric acid solution and saturated aqueous sodium chloride solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and the residue was subjected to a silica gel column chromatography (chloroform) to give 366 mg of the title compound. TLC: Rf 0.94 (chloroform:methanol = 9:1)

[Process 3] m-(iPro)-Ph-O-CH₂-CO₂H

In 4 ml of methanol, 366 mg of the compound obtained by the process 2, 764 μ l of 4N-NaOH aqueous solution was added under ice cooling and the resultant solution was stirred for 60 min at room temperature. The reaction mixture was neutralized with acetic acid and evaporated under reduced pressure. The resultant residue was redissolved in ethyl acetate and washed with 5% aqueous citric acid solution and saturated aqueous sodium chloride solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and the residue was crystallized by an addition of ether to give 310 mg of the title compound.

TLC: Rf 0.19 (chloroform:methanol = 9:1)

[Process 4] m-(iPro)-ph-O-CH₂-CO-Msa-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 105 mg of the compound obtained by Example 105 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 24 μ l of triethylamine under ice cooling. To the neutralized solution, 38 mg of m-(iPro)-Ph-O-CH₂-CO₂H, 80 mg of Bop reagent and 48 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 98 to give 5.1 mg of the title compound. Analytical HPLC: 29.51 min (For the condition, see: Example 35).

FAB-MS: 735 (M+1)

Example 167: m-(Piper-CO)-Ph-O-CH₂-CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] m-(Piperidinocarbonyl)phenol[m-(Piper-CO)-Ph-OH]

In 15 ml of DMF, 700 mg of m-hydroxybenzoic acid was dissolved, and 2.84 ml of piperidine, 3.80 g of Bop reagent and 70 mg of 4-dimethylaminopyridine were added under ice cooling, and the resultant mixture was stirred for 15 hr. The reaction mixture was evaporated under reduced pressure and the residue was redissolved in ethyl acetate. The ethyl acetate solution was washed with 5% citric acid aqueous solution and saturated sodium chloride aqueous solution, successively, and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and subjected to a silica gel column chromatography (chloroform) to give 267 mg of the title compound.

TLC: Rf 0.83 (chloroform : methanol:acetic acid = 9:1:0.5)

[Process 2] m-(Piper-CO)-Ph-O-CH₂-CO₂C₂H₅

In 5 ml of THF, 267 mg of the compound obtained by the process 1 was dissolved and 316 μ l of DBU was added under ice cooling. The resultant mixture was stirred for 10 min. To the mixture, 173 μ l of ethyl bromoacetate was added and refluxed for 2 hr. The reaction mixture was neutralized with acetic acid and treated similarly to that in the process 1 to give 112 mg of the title compound.

TLC: Rf 0.69 (chloroform:methanol = 20:1)

[Process 3] m-(Piper-CO)-Ph-O-CH₂-CO₂H

In 3 ml of methanol, 110 mg of the product obtained by the process 2 was dissolved and 303 μ l of 4N-NaOH aqueous solution was added under ice cooling. The resultant solution was stirred for 60 min at room temperature. The reaction mixture was evaporated under reduced pressure, redissolved in ethyl acetate, washed with 5% aqueous citric acid solution and saturated aqueous sodium chloride solution and dried over anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure and crystallized from ether to give 92 mg of the title compound.

TLC: Rf 0.23 (chloroform:methanol:water = 8:3:1, lower layer)

[Process 4] m-(Piper-CO)-Ph-O-CH₂-CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 42 mg of the compound obtained by Example 100 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 9.1 μ l of triethylamine under ice cooling. To the neutralized solution, 18 mg of m-(piperidinocarbonyl)-phenoxyacetic acid, 29 mg of Bop reagent and 18.2 μ l of triethylamine were added and the resultant mixture

was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 98 to give 20.4 mg of the title compound.

TLC: Rf 0.17 (chloroform : methanol = 20:1)

Analytical HPLC: 23.31 min (For the condition, see: Example 35).

FAB-MS: 760 (M+1)

Example 168: m-(Morph-CO)-Ph-O-CH₂-CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu

[Process 1] m-(Morpholinocarbonyl)phenol[m-(Morph-CO)-Ph-OH]

In 15 ml of DMF, 700 mg of m-hydroxybenzoic acid was dissolved, and 2.50 ml of morpholine, 3.04 g of Bop reagent were added under ice cooling, and the resultant mixture was stirred for 3 hr. The reaction mixture was treated similarly to that in Example 28 (Process 2) to give 1.10 g of the title compound.

TLC: Rf 0.34 (chloroform : methanol = 20:1)

[Process 2] m-(Morph-CO)-Ph-O-CH₂-CO₂C₂H₅

In THF, 500 mg of the compound obtained by the process 1 was dissolved and 531 μ l of methanol solution of sodium methanolate was added under ice cooling. The resultant mixture was stirred for 10 min. To the mixture, 295 μ l of ethyl bromoacetate was added and refluxed for 2 hr. The reaction mixture was treated similarly to that in Example 167 (Process 2) except for the chromatography solvent (chloroform : methanol = 40:1) to give 243 mg of the title compound.

TLC: Rf 0.82 (chloroform:methanol = 9:1)

[Process 3] m-(Morph-CO)-Ph-O-CH₂-CO₂H

In methanol, 243 mg of the product obtained by the process 2 was dissolved and 621 μ l of 4N-NaOH aqueous solution was added under ice cooling. The resultant solution was stirred for 60 min at room temperature. The reaction mixture was treated similarly to that in Example 167 (Process 3) to give 56 mg of the title compound.

TLC: Rf 0.82 (chloroform:methanol = 9:1)

[Process 4] m-(Morph-CO)-Ph-O-CH₂-CO-Msa-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 28 mg of the compound obtained by Example 100 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 6.1 μ l of triethylamine under ice cooling. To the neutralized solution, 12 mg of m-(Morph-CO)-Ph-O-CH₂-CO₂H, 20 mg of Bop reagent and 12.1 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give 12.1 mg of the title compound.

TLC: Rf 0.30 (chloroform : methanol = 20:1)

Analytical HPLC: 19.10 min (For the condition, see: Example 35).

FAB-MS: 762 (M+1)

Example 169: m-(iPrO)-Ph-O-CH₂-CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

Deprotection of 32 mg of the compound obtained by Example 106 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 7.3 μ l of triethylamine under ice cooling. To the neutralized solution, 11 mg of m-isopropoxyphenoxyacetic acid obtained in Example 166 (Process 3), 24 mg of Bop reagent and 14.6 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give 7.8 mg of the title compound.

Analytical HPLC: 26.68 min (For the condition, see: Example 35).

FAB-MS: 700 (M+1)

Example 170: 1-Naphthoxyacetyl-Alg-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] Boc-Alg-(2S,3S)-AHPBA-Thz-NH-tBu

- 5 Deprotection of 58 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 17.3 μ l of triethylamine under ice cooling. To the neutralized solution, 54 mg of Boc-L-allylglycine.DCHA, 61 mg of Bop reagent and 19 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 139 (Process 2) to give 76 mg of the title compound.
- 10 TLC: Rf 0.66 (chloroform : methanol = 20:1)

[Process 2] 1-Naphthoxyacetyl-Alg-(2S,3S)-AHPBA-Thz-NH-tBu

- 15 Deprotection of 76 mg of the compound obtained by the process 1 was performed similarly to that in Example 30 (Process 2), and the obtained product was dissolved in 3 ml of DMF and neutralized with 18.8 μ l of triethylamine under ice cooling. To the neutralized solution, 30 mg of 1-naphthoxyacetic acid, 66 mg of Bop reagent and 39.4 μ l of triethylamine were added and the resultant mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 39 mg of a crude product. In methanol, 19 mg of the product was dissolved, fractionated by reversed-phase HPLC and lyophilized to give 7.7 mg of the title compound.
- 20 TLC: Rf 0.53 (chloroform : methanol = 20:1)
Analytical HPLC: 31.26 min (For the condition, see: Example 35).
FAB-MS: 647 (M+1)

25 Example 171: 2,3-diMe-Ph-O-CH₂-CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu[Process 1] 2,3-diMe-Ph-O-CH₂-CO₂C₂H₅

- 30 To a THF solution of 500 mg of 2,3-dimethylphenol (2,3-diMe-Ph-OH), 672 μ l of DBU was added under ice cooling. The resultant mixture was stirred for 10 min at room temperature. To the mixture, 50 μ l of ethyl bromoacetate was added and refluxed for 2 hr. The reaction mixture was treated similarly to that in Example 167 (Process 2) to give 156 mg of the title compound.
- TLC: Rf 0.89 (chloroform:methanol = 20:1)

35 [Process 2] 2,3-diMe-Ph-O-CH₂-CO₂H

- In a methanol solution containing the compound obtained by the process 1, 375 μ l of 4N-NaOH aqueous solution was added under ice cooling and the resultant mixture was stirred for 60 min at room temperature and treated similarly to that in Example 166 (Process 3) to give 126 mg of the title compound.
- 40 TLC: Rf 0.20 (chloroform:methanol = 9:1)

[Process 3] 2,3-diMe-Ph-O-CH₂-CO-Asn-(2S,3S)-AHPBA-Dtc-NH-tBu

- 45 Deprotection of 33 mg of the compound obtained by Example 106 (Process 1) was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in 3 ml of DMF and neutralized with 10.4 μ l of triethylamine under ice cooling. To the neutralized solution, 14 mg of 2,3-dimethylphenoxyacetic acid, 33 mg of Bop reagent and 20.7 μ l of triethylamine were added and obtained mixture was stirred for 2 hr. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give 6.1 mg of the title compound.
- 50 TLC: Rf 0.43 (chloroform:methanol = 9:1)
Analytical HPLC: 26.55 min (For the condition, see: Example 35).
FAB-MS: 671 (M+1)

Example 172: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-Gly-NH₂55 [Process 1] Boc-Thz-Gly-NH₂

- Deprotection of 500 mg of Boc-Gly-NH₂ was performed similarly to that in Example 28 (Process 3), and the obtained product was dissolved in dichloromethane, and 0.39 ml of tri-ethylamine, 0.67 g of Boc-Thz-OH,

0.47 g of HOBt and 0.64 g of EDC hydrochloride were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 139 (Process 2) to give 0.54 g of the title compound as oil.

TLC: Rf 0.63 (chloroform : methanol = 9:1)

5

[Process 2] Boc-(2S,3S)-AHPBA-Thz-Gly-NH₂

Deprotection of 540 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 90 μ l of triethylamine, 100 mg of Boc-(2S,3S)-AHPBA-OH and 160 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 13.5 mg of title compound.

TLC: Rf 0.48 (chloroform:methanol = 9:1)

10

15 [Process 3] Boc-Msa-(2S,3S)-AHPBA-Thz-Gly-NH₂

Deprotection of 13.5 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 5 μ l of triethylamine, 13 mg of Boc-Msa-OH and 21 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 20 mg of title compound.

TLC: Rf 0.15 (chloroform:methanol = 9:1)

20

25 [Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-Gly-NH₂

Deprotection of 20 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 6 μ l of triethylamine under ice cooling. To the neutralized solution, 9 mg of 1-naphthoxy-acetic acid and 21 mg of Bop reagent were added and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 3 mg of the title compound.

Analytical HPLC: 20.06 min (For the condition, see: Example 35).

FAB-MS: 700 (M+1)

30

35 Example 173: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-GABA-NH₂

[Process 1] Boc-Thz-GABA-NH₂

Deprotection of 400 mg of 4-N-t-butoxycarbonylamino-butanamide [Boc-GABA-NH₂] was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane, and 0.28 ml of tri-ethylamine, 0.47 g of Boc-Thz-OH, 1.06 g of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 27 mg of the title compound.

TLC: Rf 0.56 (chloroform : methanol = 9:1)

40

45 [Process 2] Boc-(2S,3S)-AHPBA-Thz-GABA-NH₂

Deprotection of 95 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 42 μ l of triethylamine, 89 mg of Boc-(2S, 3S)-AHPBA-OH and 146 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 62 mg of title compound.

TLC: Rf 0.30 (chloroform:methanol = 9:1)

50

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Thz-GABA-NH₂

Deprotection of 62 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 17.5 μ l of triethylamine, 37 mg of Boc-Msa-OH and 61 mg of Bop reagent were added under ice cooling and the mixture

55

was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 30 mg of the title compound.

TLC: Rf 0.18 (chloroform:methanol = 9:1)

5 [Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-GABA-NH₂

Deprotection of 30 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 6.6 μ l of triethylamine under ice cooling. To the neutralized solution, 9.5 mg of 1-naphthoxyacetic acid and 23 mg of Bop reagent were added and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 2 mg of the title compound.

Analytical HPLC: 20.58 min (For the condition, see: Example 35).

FAB-MS: 728 (M+1)

15 Example 174: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-BAIB-NH₂

[Process 1] Boc-Thz-BAIB-NH₂

Deprotection of 400 mg of 3-N-t-butoxycarbonylamino-2-methylpropanamide [Boc-BAIB-NH₂] was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane, and 0.29 ml of triethylamine, 0.47 g of Boc-Thz-OH, 1.06 g of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 0.52 g of the title compound.

TLC: Rf 0.83 (chloroform : methanol = 9:1)

25 [Process 2] Boc-(2S,3S)-AHPBA-Thz-BAIB-NH₂

Deprotection of 130 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 56 μ l of triethylamine, 180 mg of Boc-(2S,3S)-AHPBA-OH and 194 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 40 mg of the title compound.

TLC: Rf 0.48 (chloroform:methanol = 9:1)

35 [Process 3] Boc-Msa-(2S,3S)-AHPBA-Thz-BAIB-NH₂

Deprotection of 40 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 11 μ l of triethylamine, 24 mg of Boc-Msa-OH and 39 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 30 mg of the title compound.

TLC: Rf 0.52 (chloroform:methanol = 9:1)

45 [Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-BAIB-NH₂

Deprotection of 30 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 6.6 μ l of triethylamine under ice cooling. To the neutralized solution, 10 mg of 1-naphthoxyacetic acid and 25 mg of Bop reagent were added and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 5 mg of the title compound.

Analytical HPLC: 21.27 min (For the condition, see: Example 35).

FAB-MS: 728 (M+1)

55 Example 175: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-BANB-NH₂

[Process 1] Boc-Thz-BANB NH₂

Deprotection of 400 mg of 3-N-t-butoxycarbonylamino-butanamide [Boc-BANB-NH₂] was performed simi-

larly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane, and 0.29 ml of triethylamine, 0.47 g of Boc-Thz-OH, 1.06 g of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 0.38 g of the title compound.

TLC: Rf 0.67 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Thz-BANB-NH₂

Deprotection of 130 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 77 μ l of triethylamine, 162 mg of Boc-(2S,3S)-AHPBA-OH and 270 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 60 mg of the title compound.

TLC: Rf 0.48 (chloroform:methanol = 9:1)

[Process 3] Boc-Msa-(2S,3S)-AHPBA-Thz-BANB-NH₂

Deprotection of 60 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 17 μ l of triethylamine, 36 mg of Boc-Msa-OH and 58 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 30 mg of the title compound.

TLC: Rf 0.51 (chloroform:methanol = 9:1)

[Process 4] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Thz-BANB-NH₂

Deprotection of 30 mg of the compound obtained by the process 3 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF and neutralized with 6.6 μ l of triethylamine under ice cooling. To the neutralized solution, 10 mg of 1-naphthoxy-acetic acid and 25 mg of Bop reagent were added and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 3 mg of the title compound.

Analytical HPLC: 20.74 min (For the condition, see: Example 35).

FAB-MS: 728 (M+1)

Example 176: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-sBu

[Process 1] Boc-Pro-NH-CH(CH₃)(C₂H₅) [Boc-Pro-NH-sBu]

In dichloromethane solution containing 0.1 g of sec-butylamine, 0.5 g of Boc-Pro-OH, 0.2 g of HOBt and 0.3 g of EDC hydrochloride were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.4 g of the title compound.

TLC: Rf 0.84 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Pro-NH-sBu

Deprotection of 57 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane. To the solution, 29 μ l of triethylamine, 100 mg of Boc-(2S,3S)-AHPBA-OH and 112 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.12 g of the title compound.

TLC: Rf 0.46 (chloroform:methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Pro-NH-sBu

Deprotection of 60 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane. To the solution, 19 μ l of triethylamine and 52 mg of benzyloxycarbonyl-Asn-ONp were added under ice cooling and the mixture was

stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 2 mg of the title compound.

Analytical HPLC: 20.14 min (For the condition, see: Example 35).

FAB-MS: 596 (M+1)

5

Example 177: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Dtc-NH₂

[Process 1] Boc-Dtc-NH₂

10 A THF solution containing 0.2 g of Boc-Dtc-OH was chilled to -15°C and 108 µl of triethylamine and 101 µl of isobutyl chloroformate were added. Further 15 min later, 2 ml of ammonia water (28%) was added and the mixture was stirred overnight. The reaction mixture was evaporated under reduced pressure and the residue was redissolved in ethyl acetate, washed with 5% aqueous sodium hydrogen-carabonate solution, 10% aqueous citric acid solution and saturated aqueous sodium chloride solution, successively, and dried over
15 anhydrous sodium sulfate. The dried solution was evaporated under reduced pressure to give 0.12 g of the title compound as oil.

TLC: Rf 0.48 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Dtc-NH₂

20 Deprotection of 120 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane. To the solution, 64.4 µl of triethylamine, 219 mg of Boc-(2S,3S)-AHPBA-OH and 224 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to
25 that in Example 144 (Process 2) to give 170 mg of the title compound.

TLC: Rf 0.61 (chloroform:methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Dtc-NH₂

30 Deprotection of 44 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 14 µl of triethylamine and 78 mg of benzyloxycarbonyl-Asn-ONp were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give
35 1 mg of the title compound.

Analytical HPLC: 21.90 min (For the condition, see: Example 35).

FAB-MS: 586 (M+1)

Example 178: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-decahydroisoquinoline

40 [Process 1] Boc-(2S,3S)-AHPBA-Diq

In dichloromethane solution containing 28 mg of decahydroisoquinoline, 96 mg of Boc-(2S,3S)-AHPBA-OH, 102 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 0.12 g of the
45 title compound.

TLC: Rf 0.64 (chloroform : methanol = 20:1)

[Process 2] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Diq

50 Deprotection of 120 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 28 µl of triethylamine and 93 mg of benzyloxycarbonyl-Asn-ONp were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give
55 2 mg of the title compound.

Analytical HPLC: 31.57 min (For the condition, see: Example 35).

FAB-MS: 565 (M+1)

¹H NMR (DMSO-d₆, 500 MHz): Fig. 6

Example 179: 1-Naphthoxyacetyl-Val-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] Boc-Val-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 45 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 14 μ l of triethylamine, 22 mg of Boc-Val-OH and 53 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 40 mg of the title compound.

TLC: Rf 0.69 (chloroform:methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Val-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 40 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. The solution was neutralized with 10 μ l of triethylamine under ice cooling. To the neutralized solution, 14 mg of 1-naphthoxyacetic acid and 37 mg of Bop reagent were added and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 2 mg of the title compound.

Analytical HPLC: 30.54 min (For the condition, see: Example 35).

FAB-MS: 649 (M+1)

Example 180: 1-Naphthoxyacetyl-Prg-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] N-(t-butoxycarbonyl)propargylglycine[Boc-Prg-OH]

In a THF solution containing 1.0 g of diethyl N-benzyloxycarbonylaminomalonate, 0.17 g of sodium hydride (60% in oil) was added under ice cooling and the mixture was stirred for 30 min. The reaction mixture was evaporated under reduced pressure and redissolved in dimethylsulfoxide (DMSO). To the solution, 0.36 ml of propargyl bromide was added and the mixture was stirred overnight. The reaction mixture was mixed with water and extracted with ether. The ether layer was washed with saturated aqueous sodium chloride and dried over sodium sulfate. The dried solution was evaporated under reduced pressure and the residue was hydrolyzed with 2N-NaOH for 5 hr, followed by t-butoxy-carbonylation with (Boc)₂O to give 0.6 g of the title compound.

TLC: Rf 0.37 (chloroform : methanol = 5:1)

[Process 2] Boc-Prg-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 55 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 20 μ l of triethylamine, 55 mg of Boc-Prg-OH and 76 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 80 mg of the title compound.

TLC: Rf 0.76 (chloroform:methanol = 9:1)

[Process 3] 1-Naphthoxyacetyl-Prg-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 80 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. The solution was neutralized with 19.6 μ l of triethylamine under ice cooling. To the neutralized solution, 28 mg of 1-naphthoxyacetic acid and 74 mg of Bop reagent were added and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 1 mg of the title compound.

Analytical HPLC: 29.74 min (For the condition, see: Example 35).

FAB-MS: 645 (M+1)

Example 181: 1-Naphthoxyacetyl-Aca-(2S,3S)-AHPBA-Thz-NH-tBu[Process 1] 2-(N-t-butoxycarbonylamino)-4-oxopentanoic acid[Boc-Aca-OH]

In a THF solution containing 1 g of diethyl N-benzyloxy-carbonylaminomalonate, 0.17 g of sodium hydride

was added under ice cooling and the mixture was stirred for 30 min. The reaction mixture was evaporated under reduced pressure and redissolved in DMSO. To the solution, 0.26 ml of bromoacetone was added under ice cooling and the mixture was stirred overnight. The reaction mixture was treated similarly to that in Example 180 (Process 1) to give 294 mg of the title compound.

5 TLC: Rf 0.24 (chloroform : methanol = 5:1)

[Process 2] Boc-Aca-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 63 mg of the compound obtained by Example 82 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 31 μ l of triethylamine, 90 mg of Boc-Aca-OH and 117 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 30 (Process 4) to give 40 mg of the title compound.

TLC: Rf 0.74 (chloroform:methanol = 9:1)

15 [Process 3] 1-Naphthoxyacetyl-Aca-(2S,3S)-AHPBA-Thz-NH-tBu

Deprotection of 40 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. The solution was neutralized with 9.7 μ l of triethylamine under ice cooling. To the neutralized solution, 14 mg of 1-naphthoxyacetic acid and 37 mg of Bop reagent were added and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 1 mg of the title compound.

Analytical HPLC: 25.79 min (For the condition, see: Example 35).

FAB-MS: 663 (M+1)

25 Example 182: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Dmp-NH-tBu

[Process 1] Boc-Dmp-NH-tBu

30 In dichloromethane solution containing 95 mg of tert-butylamine, 280 mg of 1-t-butoxycarbonyl-3, 3-dimethyl-pyrrolidine-2-carboxylic acid [Boc-Dmp-OH] and 320 mg of 2-chloro-1,3-dimethylimidazolium hexafluorophosphate were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 28 (Process 3) to give 90 mg of the title compound.

TLC: Rf 0.86 (chloroform : methanol = 20:1)

35 [Process 2] Boc-(2S,3S)-AHPBA-Dmp-NH-tBu

Deprotection of 90 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane. To the solution, 89 mg of Boc-(2S,3S)-AHPBA-OH and 159 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 82 mg of the title compound.

TLC: Rf 0.78 (chloroform : methanol = 9:1)

45 [Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Dmp-NH-tBu

Deprotection of 65 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution was added with 19 μ l of triethylamine, 80 mg of benzyloxycarbonyl-Asn-ONp, 32 mg of HOBt and 23 μ l of N-methylmorpholine under ice cooling, and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 132 (Process 2) to give a crude title compound. The crude solid was dissolved in methanol and subjected to a reversed-phase HPLC (water-acetonitrile system), fractionated, purified and lyophilized to give 10.3 mg of the title compound.

Analytical HPLC: 23.06 min (For the condition, see: Example 35).

55 FAB-MS: 624 (M+1)

Example 183: 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Dmp-NH-tBu[Process 1] Boc-Msa-(2S,3S)-AHPBA-Dmp-NH-tBu

5 Deprotection of 82 mg of the compound obtained by Example 182 (Process 2) was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution, 81 mg of Boc-Msa-OH and 134 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 78 mg of the title compound.

10 TLC: Rf 0.54 (chloroform : methanol = 9:1)

[Process 2] 1-Naphthoxyacetyl-Msa-(2S,3S)-AHPBA-Dmp-NH-tBu

15 Deprotection of 78 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. The solution was neutralized with 15.4 μ l of triethylamine under ice cooling. To the neutralized solution, 23 mg of 1-naphthoxyacetic acid and 54 mg of Bop reagent were added and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 3 mg of the title compound.

Analytical HPLC: 29.27 min (For the condition, see: Example 35).

20 FAB-MS: 709 (M+1)

Example 184: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Php-NH-tBu[Process 1] Boc-Php-NH-tBu

25 In dichloromethane solution containing 50 mg of tert-butylamine, 200 mg of 1-t-butoxycarbonyl 3-phenylpyrrolidine-2-carboxylic acid (Boc-Php-OH) and 140 mg of 2-chloro-1,3-dimethylimidazolinium hexafluorophosphate were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 139 (Process 2) to give 190 mg of the title compound.

30 TLC: Rf 0.83 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-Php-NH-tBu

35 Deprotection of 190 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane. To the solution, 37 μ l of triethylamine, 261 mg of Boc-(2S,3S)-AHPBA-OH and 292 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 132 (Process 1) to give 100 mg of the title compound.

TLC: Rf 0.78 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Php-NH-tBu

40 Deprotection of 100 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution were added 26.6 μ l of triethylamine and 77 mg of benzyloxycarbonyl-Asn-ONp under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 2 mg of the title compound.

Analytical HPLC: 25.62 min (For the condition, see: Example 35).

50 FAB-MS: 672 (M+1)

Example 185: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Cpp-NH-tBu[Process 1] Boc-Cpp-NH-tBu

55 In dichloromethane solution containing 25 mg of tert-butylamine, 100 mg of cis-1-t-butoxycarbonyl-4-phenylpyrrolidine-2-carboxylic acid (Boc-Cpp-OH), 50 mg of HOBt and 79 mg of EDC hydrochloride were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 90 mg of the title compound.

TLC: Rf 0.86 (chloroform : methanol = 20:1)

[Process 2] Boc-(2S,3S)-AHPBA-Cpp-NH-tBu

Deprotection of 35 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane. To the solution, 14 μ l of triethylamine, 48 mg of Boc-(2S,3S)-AHPBA-OH and 53 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 60 mg of the title compound.

TLC: Rf 0.78 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Cpp-NH-tBu

Deprotection of 30 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution were added 8.4 μ l of triethylamine and 23 mg of benzyloxycarbonyl-Asn-ONp under ice cooling and the mixture was treated similarly to that in Example 122 to give 2 mg of the title compound.

Analytical HPLC: 26.23 min (For the condition, see: Example 35).

FAB-MS: 672 (M+1)

Example 186: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Tcp-NH-tBu

[Process 1] Boc-Tcp-NH-tBu

In dichloromethane solution containing 25 mg of tert-butylamine, 100 mg of trans-1-t-butoxycarbonyl-4-cyclo-hexylpyrrolidine-2-carboxylic acid (Boc-Tcp-OH), 63 mg of HOBt and 84 mg of EDC hydrochloride were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 160 mg of the title compound.

TLC: Rf 0.90 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Tcp-NH-tBu

Deprotection of 35 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane. To the solution, 14 μ l of triethylamine, 49 mg of Boc-(2S,3S)-AHPBA-OH and 53 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 40 mg of the title compound.

TLC: Rf 0.52 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Tcp-NH-tBu

Deprotection of 40 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution were added 11.2 μ l of triethylamine and 32 mg of benzyloxycarbonyl-Asn-ONp under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 3 mg of the title compound.

Analytical HPLC: 30.16 min (For the condition, see: Example 35).

FAB-MS: 678 (M+1)

Example 187: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Ccp-NH-tBu

[Process 1] Boc-Ccp-NH-tBu

In a dichloromethane solution containing 25 mg of tert-butylamine, 110 mg of cis-1-t-butoxycarbonyl-4-cyclohexylpyrrolidine-2-carboxylic acid (Boc-Ccp-OH), 63 mg of HOBt and 84 mg of EDC hydrochloride were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 144 (Process 2) to give 170 mg of the title compound.

TLC: Rf 0.87 (chloroform : methanol = 9:1)

[Process 2] Boc-(2S,3S)-AHPBA-Ccp-NH-tBu

Deprotection of 35 mg of the compound obtained by the process 1 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in dichloromethane. To the solution, 14 μ l of triethylamine, 48 mg of Boc-(2S,3S)-AHPBA-OH and 53 mg of Bop reagent were added under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 93 (Process 3) to give 20 mg of the title compound.

TLC: Rf 0.78 (chloroform : methanol = 9:1)

[Process 3] Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Ccp-NH-tBu

Deprotection of 20 mg of the compound obtained by the process 2 was performed similarly to that in Example 125 (Process 2), and the obtained product was dissolved in DMF. To the solution were added 5.6 μ l of triethylamine and 16 mg of benzyloxycarbonyl-Asn-ONp under ice cooling and the mixture was stirred overnight at room temperature. The reaction mixture was treated similarly to that in Example 122 to give 2 mg of the title compound.

Analytical HPLC: 29.94 min (For the condition, see: Example 35).

FAB-MS: 678 (M+1)

Example 188: Benzyloxycarbonyl-Asn-(2S,3S)-AHPBA-Dmp-NH₂

The title compound was obtained by a similar method to that of Example 177.

Analytical HPLC: 22.00 min (For the condition, see: Example 35).

FAB-MS: 568 (M+1)

Example 189: Inhibitory assay using chemically synthesized HIV protease

The HIV protease was chemically synthesized by replacement of two cysteine residues in the natural sequence [Science, 230, 949 (1985)] with alanine residues. The reaction mixture contained 100 mM MES buffer (pH 5.5), 40 mM of substrate (Ac-Arg-Ala-Ser-Gln-Asn-Tyr-Pro-Val-Val-NH₂ trifluoro-acetate), inhibitors at varying concentrations dissolved in DMSO and 9.2 μ g of the HIV protease in a total volume of 15 μ l. Incubation was carried out at 37 °C for 60 min. The reaction was started by the addition of the enzyme and terminated by 15 μ l of acetonitrile. The amount of a fragment peptide produced was measured by reversed-phase HPLC analysis using an internal standard. The HPLC condition was as follows.

Column: VYDAC 218 TP 54, C18

Solvent A: 0.1% trifluoroacetic acid aqueous solution

Solvent B: acetonitrile

Gradient: B was increased in 1.0%/min from 100% of A,

The residual enzymic activity in the presence of 5 μ M (final concentration) of the inhibitor obtained in Example 32 was 4.0%. In addition, the inhibitor showed 60 nM of IC₅₀ and 10 nM of K_i.

The residual activities in the presence of various inhibitors were determined by similar methods and the results are shown in Tables 1-6.

Example 190: Inhibitory activity assay using recombinant HIV protease

The inhibitory assay using recombinant HIV protease with the natural amino acid sequence expressed by *Escherichia coli* [Biochemistry, 29, 264 (1990)] was performed by a similar condition to that in Example 189, except for the amount of the enzyme used (2.0 μ g). The residual enzymic activity in the presence of 5 μ M (final concentration) of the inhibitor obtained in Example 32 was 11.0%.

Example 191: Pharmaceutical preparation

(1) The peptide derivative obtained in Example 32 (10 mg), 200 mg of lactose and 10 mg of magnesium stearate were thoroughly mixed and filled in a hard capsule for oral preparation.

(2) The peptide derivative obtained in Example 32 (5 mg), vegetable oil and saline solution for injection were mixed to make an ampule preparation of 2 ml volume.

Example 192: 5Isoquinoline-O-CH₂CO-Asn-(2S,3S)-AHPBA-Thz-NH-tBu · AcOH

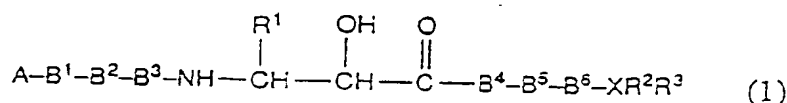
The title compound, which may be prepared from the protected peptide obtained in Example 101 (Process 1) and the carboxylic acid obtained in Example 115 (Process 1) by a similar method to that in Example 123 (Process 2), is expected to show high inhibitory activity against the HIV protease [cf. Example 101 in Table 4 and Example 115 in Table 4].

Example 193: 5Isoquinoline-O-CH₂CO-Mta-(2S,3S)-AHPBA-Thz-tBu · AcOH

The title compound, which may be prepared from the protected peptide obtained in Example 162 (Process 1) and the carboxylic acid obtained in Example 115 (Process 1) by a similar method to that in Example 123 (Process 2), is expected to show high inhibitory activity against the HIV protease [cf. Example 130 in Table 5 and Example 162 in Table 6].

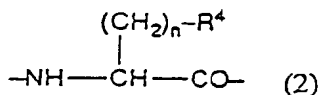
Claims

- Human immunodeficiency virus (HIV) protease inhibitor comprising compound selected from those of formula (1) and pharmaceutically acceptable salts thereof:



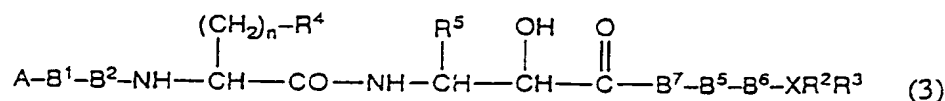
where A is a hydrogen atom or a peptide N-terminal protective group; B¹, B², B³, B⁴, B⁵, and B⁶ are selected independently from amino acid residues in which amino is optionally substituted with hydrocarbon of 12 or less carbon atoms with the proviso that at least one but at most five of said B¹ to B⁶ may be absent; R¹ is a lower alkyl, alicyclic hydrocarbon, aromatic hydrocarbon, or heterocyclic group, each optionally substituted with amino, mercapto, hydroxy, carboxy, carbamoyl, alicyclic hydrocarbon, aromatic hydrocarbon or heterocyclic group, X represents a nitrogen or oxygen atom; and R² and R³ are selected independently from a hydrogen atom and hydrocarbon groups having 12 or less carbon atoms which may form cycles of which carbon atoms may be replaced with oxygen, nitrogen or sulfur atom with the proviso that no R³ is present when X represents oxygen.

- HIV protease inhibitor according to claim 1 wherein (a) R¹ represents a benzyl, (4-hydroxyphenyl)methyl, (4-alkoxyphenyl)methyl, cyclohexylmethyl or isobutyl group; and/or (b) B⁴ is a phenylalanine residue; and/or (c) [i] all B², B³, B⁵ and B⁶ are valine residues or [ii] B³ is an amino acid residue of formula (2) and R¹ represents an optionally substituted arylmethyl group



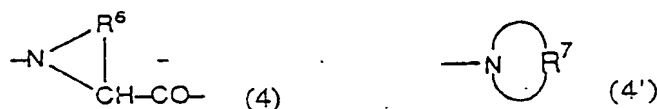
where n is 1 or 2 and R⁴ represents carbamoyl, carboxy, cyano, alkoxycarbonyl, hydroxy, lower alkoxy, lower alkylthio, lower alkanesulfonyl, sulfonyl, lower alkanesulfinyl, or sulfamoyl group.

- A compound of formula (3) or a salt thereof:



where n is 1 or 2; A is a hydrogen atom or a peptide N-terminal protective group; B¹, B², B⁵ and B⁶ are selected independently from amino acid residues with amino optionally substituted with hydrocarbon of 12 or less carbon atoms but any one or more of B¹, B², B⁵ and B⁶ may be absent; B⁷ is absent or an amino

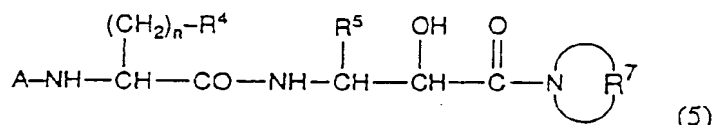
acid residue of formula (4) with the proviso that XR^2R^3 is of formula (4') when B^7 is absent; X is a nitrogen or oxygen atom; R^2 and R^3 are selected independently from a hydrogen atom and optionally substituted hydrocarbon groups of 12 or less carbon atoms which may form cycles of which carbon atoms may be replaced with oxygen, nitrogen or sulfur with the proviso that no R^3 is present when X is oxygen; R^4 is carbamoyl, carboxy, cyano, alkoxy-carbonyl, hydroxy, lower alkoxy, lower alkylthio, lower alkanesulfonyl, sulfonyl, lower alkanesulfinyl, or sulfamoyl group; R^5 represents an optionally substituted arylmethyl group; and



R^6 and R^7 are independently a bivalent hydrocarbon group forming a 5-7 membered ring optionally substituted or fused with other 5-7 membered ring, carbon atoms in said rings optionally being partially replaced by a hetero atom or atoms.

4. A compound according to claim 3 wherein A is a peptide N-terminal protective group, and B^1 , B^2 , B^5 and B^6 are all absent.

5. A compound according to claim 3 of formula (5):

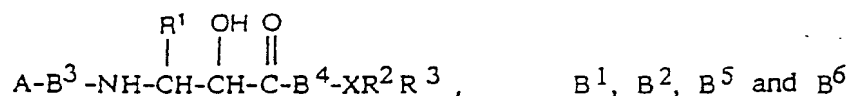


where A is a peptide N-terminal protective group and n, R^4 , R^5 and R^7 are as defined in claim 3.

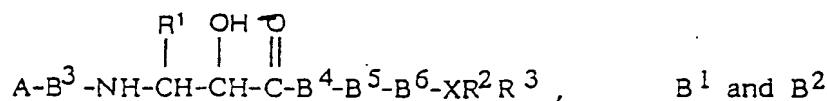
6. A compound according to claim 3,4 or 5 wherein (a) R^5 is a benzyl group; and/or (b) n is 1 and R^4 is a carbamoyl, methylthio or methanesulfonyl group; and/or (c) A is an aryloxyacetyl or heteroaryloxyacetyl group.

7. A compound according to claim 3,4,5 or 6 wherein (a) B^7 , when present, is a proline, 3,3-dimethylpyrrolidine-2-carboxylic acid, 1,3-thiazolidine-4-carboxylic acid or 5,5-dimethyl-1,3-thiazolidine-4-carboxylic acid residue; and/or (b) $\text{---XR}^2\text{R}^3$ is an N-tert-butylamino group.

8. HIV protease inhibitor according to claim 1 wherein (a) compound (1) is of formula:



being absent and the remaining substituents being as defined in claim 1; or (b) compound (1) is of formula:



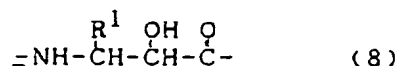
being absent and the remaining substituents being as defined in claim 1.

9. A pharmaceutical composition for inhibiting viral replication which comprises an effective protease inhibiting amount of protease inhibitor according to any preceding claim as an active ingredient for inhibiting viral replication; and a pharmaceutically acceptable carrier therefor.

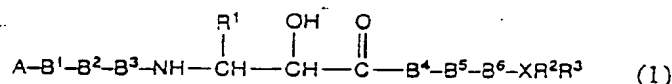
10. The use of a compound or salt as defined in any one of claims 1 to 8 for the preparation of a medicament for inhibiting viral replication.

Claims for the following Contracting States: ES, GR

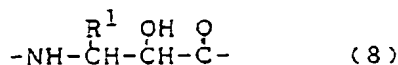
1. A process for the production of human immunodeficiency virus (HIV) protease inhibitors, the process comprising converting an amino acid derivative of general formula (8)



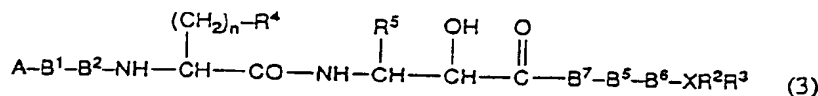
into a peptide derivative of general formula (1)



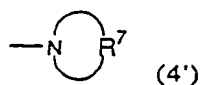
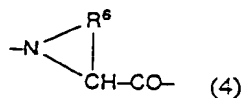
- where A represents hydrogen atom or a peptide N-terminal protective group, B¹, B², B³, B⁴, B⁵, and B⁶ represent independently single bond or amino acid residue in which the amino group optionally substituted with a hydrocarbon group having 12 or less of carbon atoms with a proviso that the presence of at least one of said B¹ through B⁶ is necessary, R¹ represents a lower alkyl group, an alicyclic hydrocarbon group, an aromatic hydrocarbon group or a heterocyclic group, each optionally substituted with amino group, mercapto group, hydroxy group, carboxy group, carbamoyl group, an alicyclic hydrocarbon group, an aromatic hydrocarbon group or a heterocyclic group, X represents nitrogen atom or oxygen atom, and R² and R³ each represents hydrogen atom or a hydrocarbon group having 12 or less carbon atoms which may form cycles of which carbon atoms may optionally be replaced with oxygen, nitrogen or sulfur atom with the proviso that no R³ is present when X represents oxygen atom and optionally forming a pharmaceutically acceptable salt thereof.
2. A process for the production of novel compounds or HIV protease inhibitors, the process comprising converting an amino acid derivative of general formula (8)



into a peptide derivative of general formula (3)



where n represents 1 or 2, A represents hydrogen atom or a peptide N-terminal protective group, B¹, B², B⁵, and B⁶ represents independently single bond or amino acid residue optionally the amino group of said amino acid be substituted with a hydrocarbon residue having 12 or less of carbon atoms, B⁷ represents a single bond or an amino acid residue represented by the following general formula (4) with a proviso that XR²R³ represents the following general formula (4') when B⁷ is a single bond, X represents nitrogen atom or oxygen atom, R² and R³ each represents hydrogen atom or an optionally substituted hydrocarbon group having 12 or less carbon atoms which may form cycles by forming bonds between said carbon atoms which may optionally be replaced with oxygen, nitrogen or sulfur atom with the proviso that no R³ is present when X represents oxygen atom, R⁴ represents carbamoyl group, carboxy group, cyano group, an alkoxycarbonyl group, hydroxy group, a lower alkoxy group, a lower alkylthio group, a lower alkanesulfonyl group, sulfonyl group, a lower alkanesulfinyl group or sulfamoyl group, and R⁵ represents an optionally substituted arylmethyl group:



where R⁶ and R⁷ represent a bivalent hydrocarbon group forming a 5-7 membered ring optionally substituted or fused with the other 5-7 membered ring, and a part of carbon atoms in said rings optionally replaced with hereto atoms and optionally forming a pharmaceutically acceptable salt thereof.

3. A process according to claim 2 wherein derivative (3) is of formula (5):

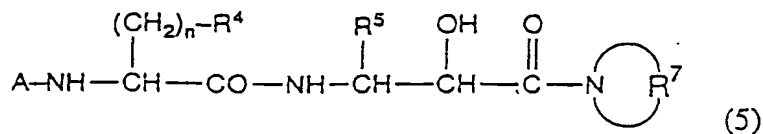
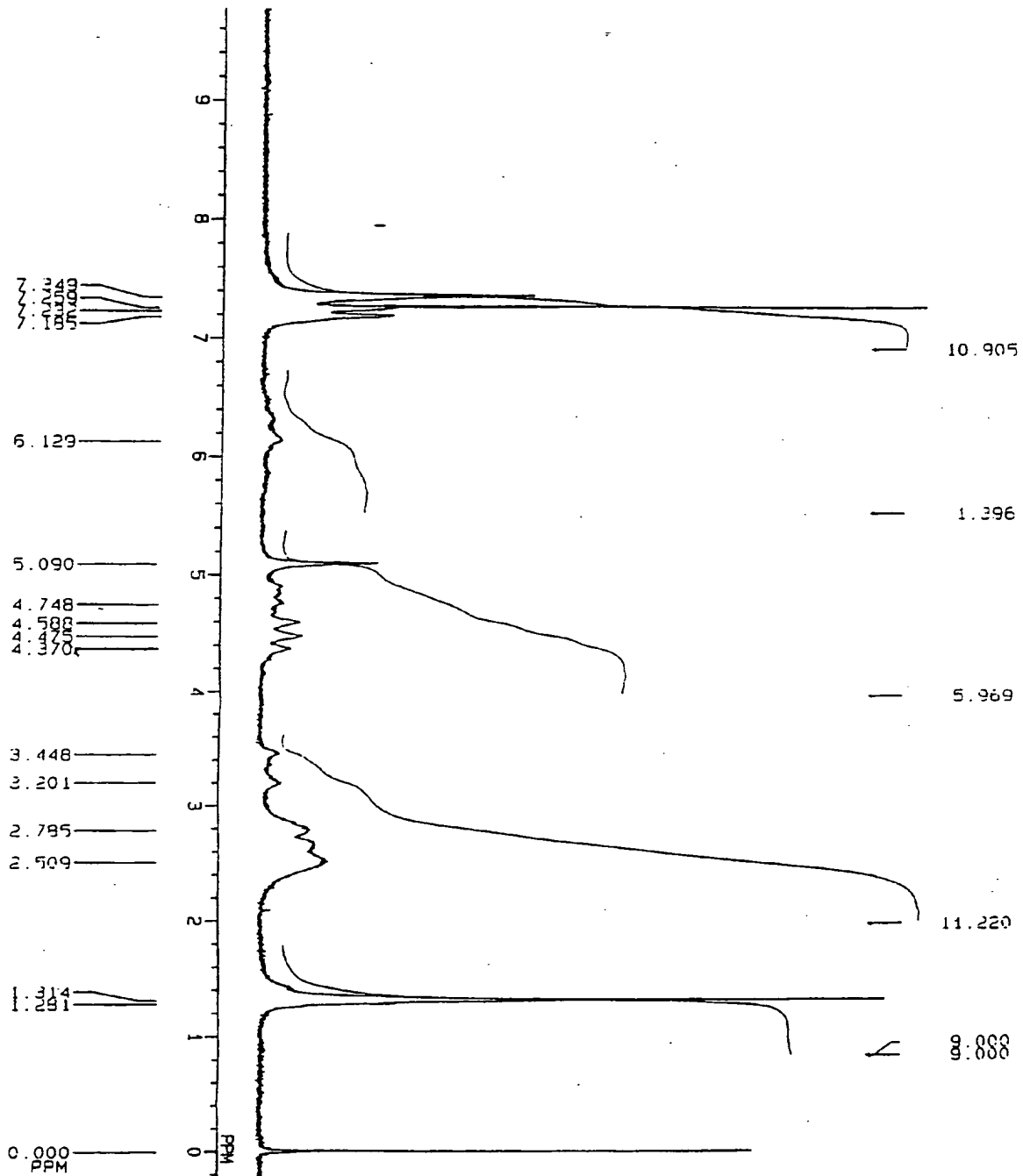
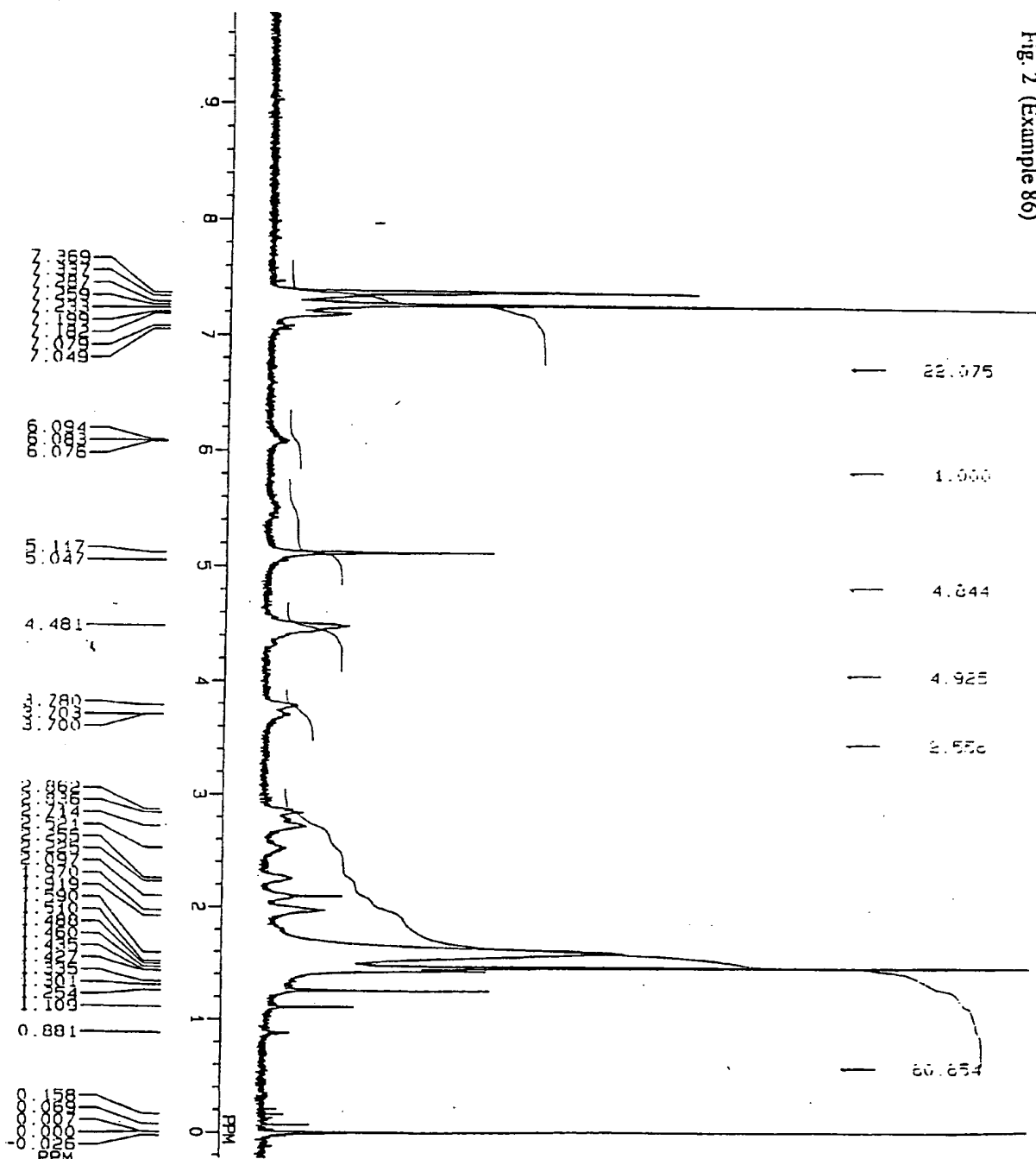


Fig. 1 (Example 82)



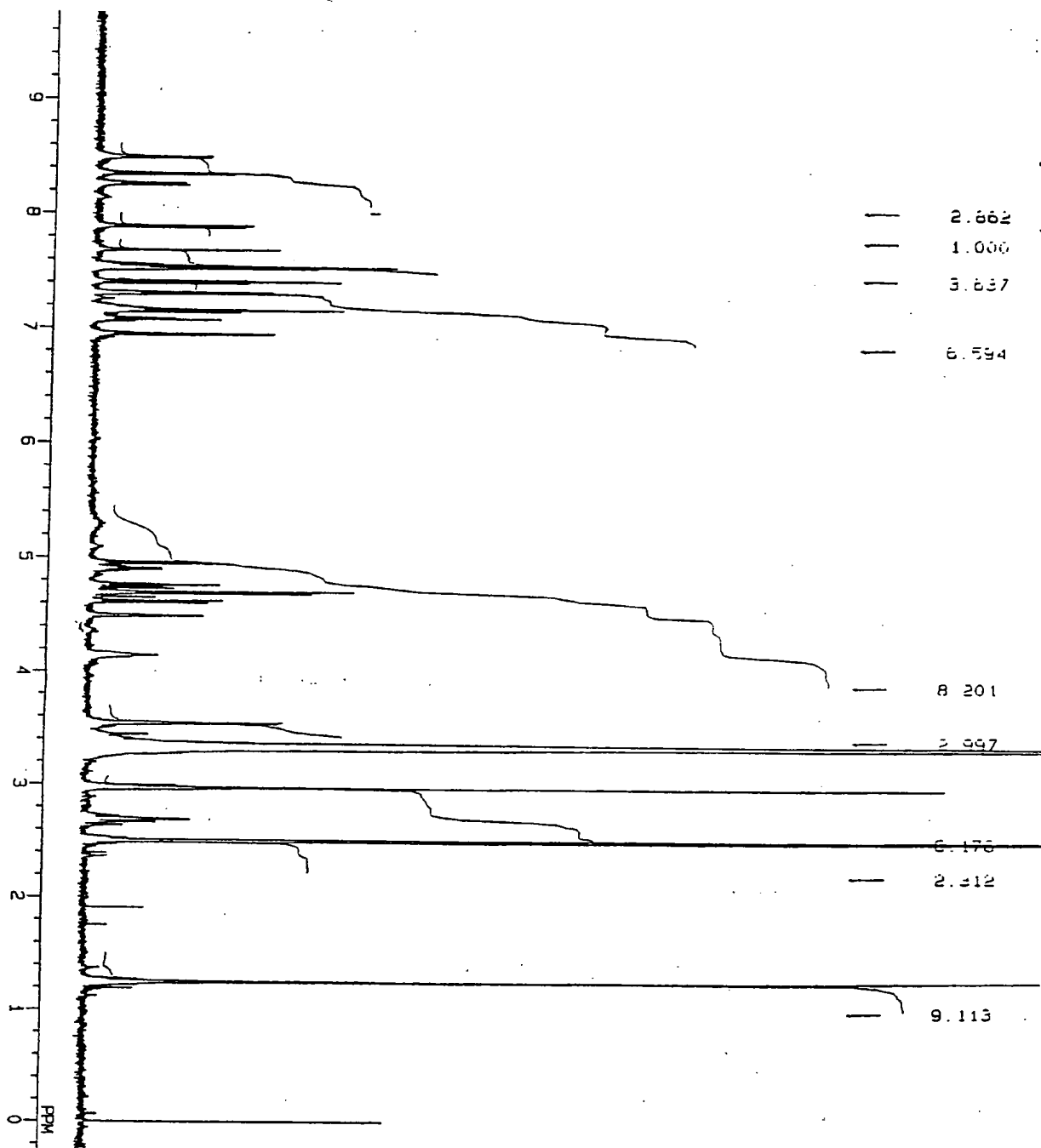
20-NOV-91 14.16.40
 COMNT KNI-125
 EXMOD SGNON
 OBNUC 1H
 OBFNO 500.00 MHz
 OBSET 152.00 kHz
 OBFIN 10157.0 Hz
 POINT 32768
 FREQU 8000.0 Hz
 FILTR 6000 Hz
 SCANS 32
 ACQTH 2.048 sec
 PD 3.000 sec
 PM1 2.6 us
 IRNUC 1H
 IRSET 152.00 kHz
 IRFIN 10157.0 Hz
 IRATN 500
 IRPMW 50 us
 TEMP. 27.0 c
 SLVNT CDCL3
 EXREF 0.00 DDM
 BF 0.10 Hz

Fig. 2 (Example 86)



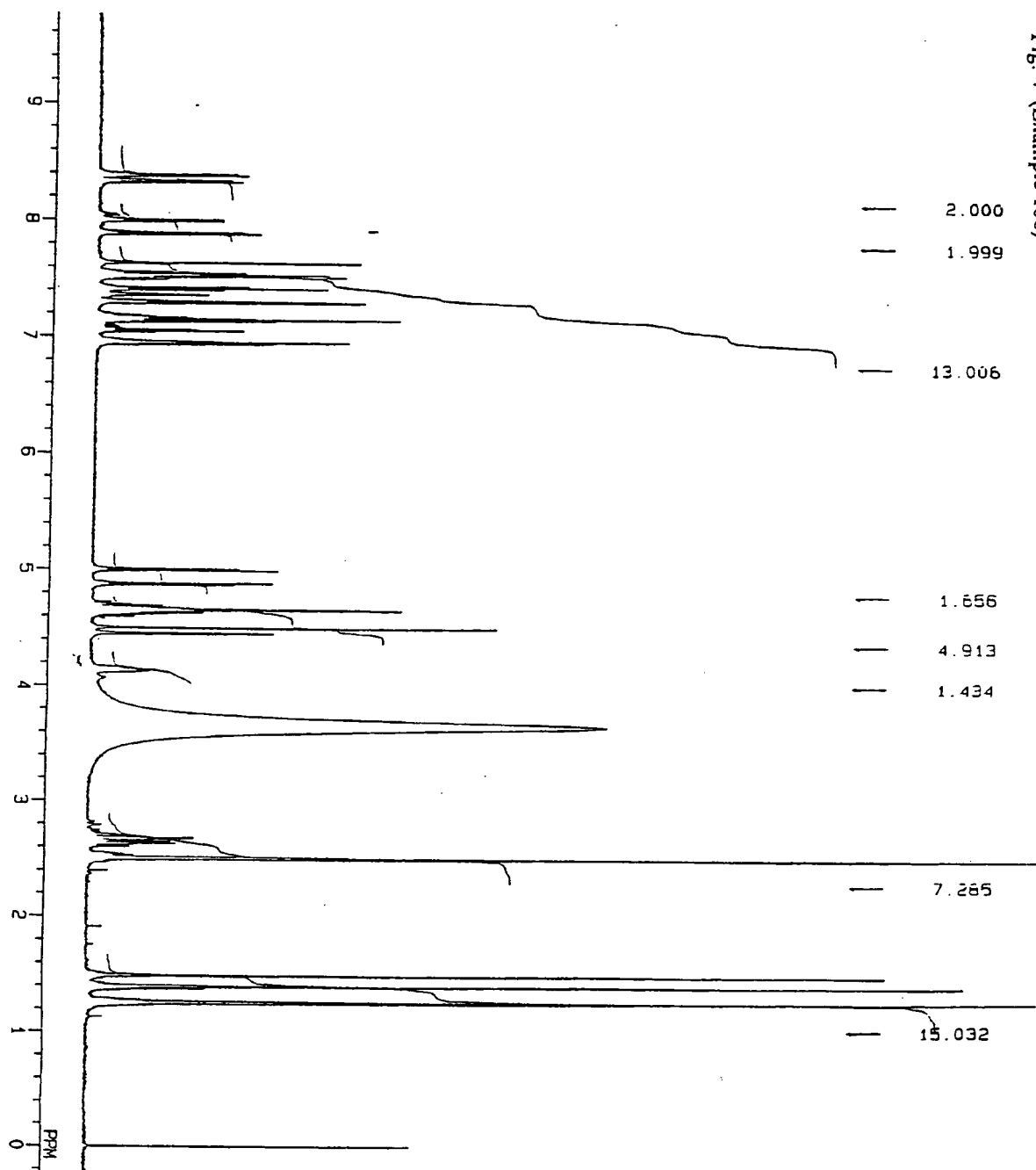
20-NOV-91	14.12.00		
COMMENT 'NT-101'			
ENDCD 50000			
ENDUC 1H			
DEFRQ	500.00	MHz	
DESET	152.00	KHz	
DEFTN	10157.0	Hz	
POINT	22759		
FREQU	5000.0	Hz	
FILTR	6000	Hz	
SCANS	128		
ACQTM	2.049	sec	
PD	2.000	sec	
PW1	2.6	us	
INRUC 1H			
IRSET	152.00	KHz	
IRFTN	10157.0	Hz	
IRATN	500		
IRAPW	50	us	
TEMP.	27.0	C	
SLVNT	COCL3		
EXREF	0.00	ppm	
BF	0.10	Hz	

Fig. 3 (Example 100)



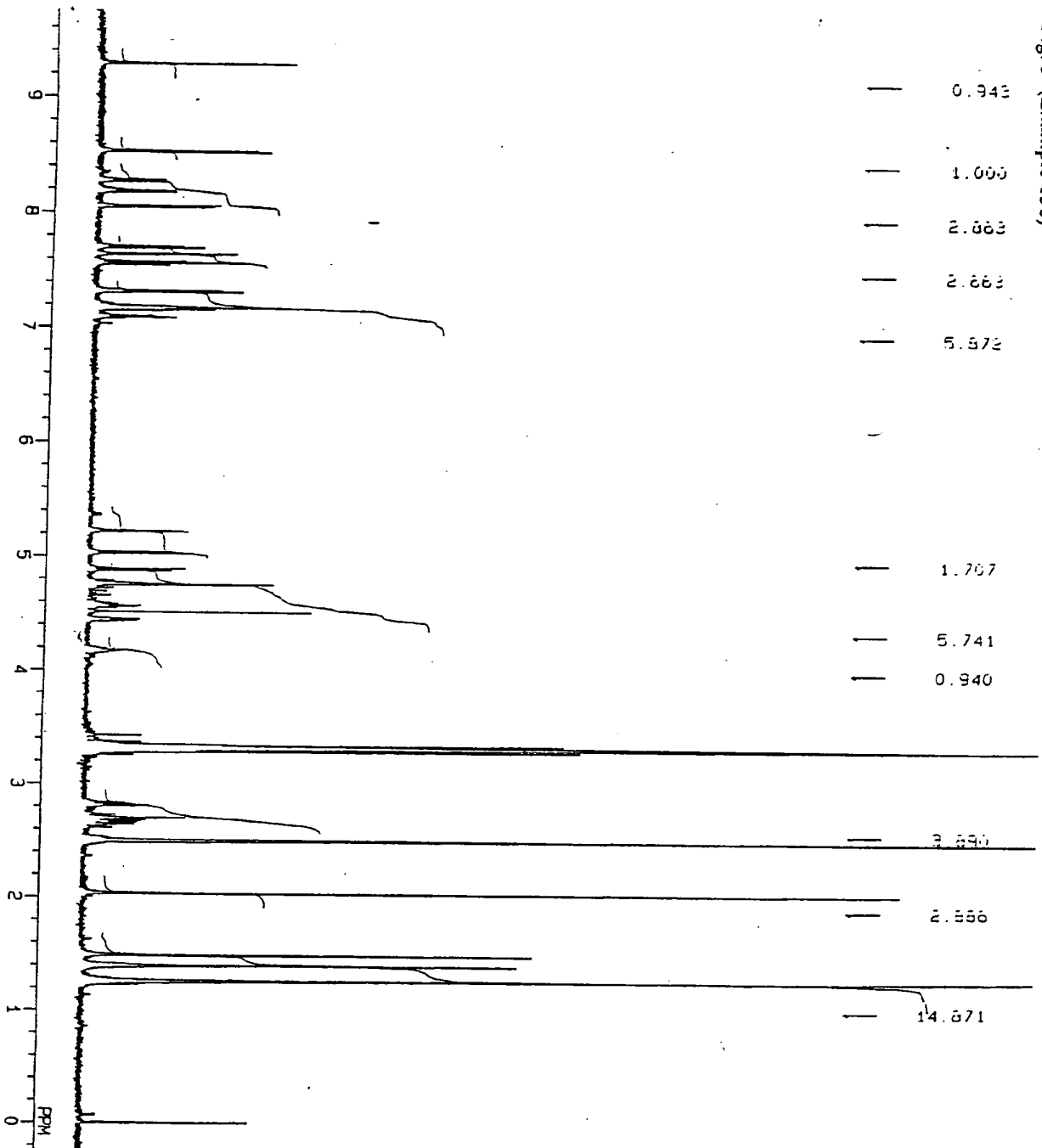
19-NOV-91 15.02.11
 COUNT KNT-131
 EXMCD 35N0N
 OBNUC 1H
 OBFRO 500.00 MHz
 OBSST 152.00 kHz
 OBFIN 10157.0 Hz
 POINT 32768
 FREOU 8000.0 Hz
 FILTR 6000 Hz
 SCANS 64
 ACQTM 2.048 sec
 PD 3.000 sec
 PUL 2.6 us
 IRNUC 1H
 IRSET 152.00 kHz
 IRFIN 10157.0 Hz
 IRATN 500
 IRRPM 50 us
 TEMP. 27.0 C
 SLVNT DMSO
 EXREF 0.00 DMS
 BF 8.10 Hz

Fig. 4 (Example 106)



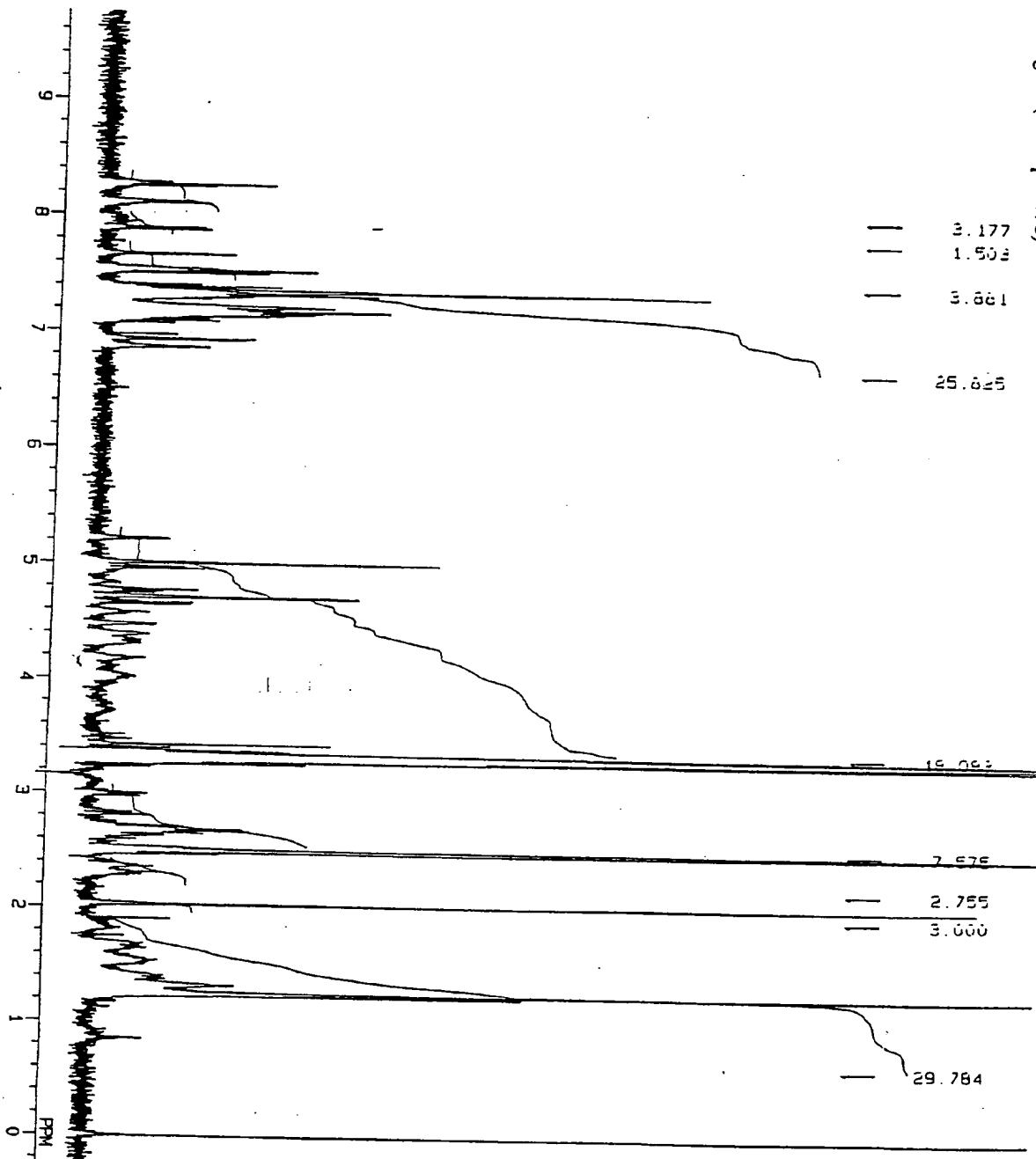
10-100 50
 COUNT KNT-174
 EXMOD SGNDN
 OBNUC 1H
 OBFRQ 500.00 MHz
 OBSET 152.00 kHz
 OBFIN 10157.0 Hz
 POINT 32768
 FREOU 8000.0 Hz
 FILTR 6000 Hz
 SCANS 32
 ACQTM 2.048 sec
 PD 3.000 sec
 PM1 2.6 us
 IRNUC 1H
 IRSET 152.00 kHz
 IRFIN 10157.0 Hz
 IRATN 500
 IRRPW 50 us
 TEMP. 27.0 C
 SLVNT DMSO
 EXREF 0.00 ppm
 BF 0.10 Hz

Fig. 5 (Example 130)



19-NOV-91 15.16.33
 COUNT UNIT-227
 EXHOD 50000
 OBNUC 1H
 OBFRQ 500.00 MHz
 OBSET 152.00 kHz
 OBFIN 10157.0 Hz
 POINT 32768
 FREQU 8000.0 Hz
 FLTR 6000 Hz
 SCANS 32
 ACQTM 2.048 sec
 PD 3.000 sec
 PM1 2.6 us
 TRNUC 1H
 IRSET 152.00 kHz
 IRFIN 10157.0 Hz
 IRATN 500
 IRPPM 50 us
 TEMP. 27.0 C
 SLVNT DMSO
 EXREF 0.00 ppm
 BF 0.10 Hz

Fig. 6 (Example 178)



20-NOV-91 13.26.59
 LOMNT KNC-156
 EXMOD 5000N
 UBNUC III
 OBFRI 500.00 MHz
 OBSET 152.00 kHz
 OBFIN 10157.0 Hz
 POINT 32768
 FREQU 8000.0 Hz
 FILTR 6000 Hz
 SCANS 128
 ACQTM 2.048 sec
 PD 3.000 sec
 PM1 2.6 us
 INNUC 1H
 IRSET 152.00 kHz
 IRFIN 10157.0 Hz
 IRATN 500
 IRPPM 50 us
 TEMP 27.0 C
 SLVNT DMSO
 EXREF 0.00 ppm
 BF 0.10 Hz